

INTERNATIONAL

Realtà MAPEI

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by **Guido Palmieri**
Realtà Mapei International's
Editor-in-Chief

An intriguing journey to the centre of the earth

There is plenty of literature about the “Italian art of tunnelling”. A history of leadership of Italian companies, designers and suppliers that goes back a long way (from Frejus tunnel that opened in 1871) and continues today. On a very competitive and aggressive international market (just think of China’s rise to prominence), Italy can boast a legacy of know-how, experience and reliability testified by its involvement in major projects in the realm of tunnelling and underground construction. Ever since it entered the market in 1999 with a range of products for this industry, Mapei has come to the fore through ground-breaking ideas. It understood the market’s expectations and set up a strategy capable of evolving with it, combining high product performance with environmental compatibility.

Realtà Mapei International has dedicated this edition’s special issue to the fascinating world of underground works. A rapidly developing industry both in Italy (over the next few years the country will benefit from the awarding of considerable resources for infrastructures linked to the PNRR - National Recovery and Resilience Plan) and also globally with important investment already underway.

Mapei is now involved in lots of these under-

ground projects in the name of innovative technological products: in Italy (from Brenner tunnel to the High-Speed railway Iline), abroad in building projects everywhere from Norway to North America and South East Asia.

Underground works will be increasingly decisive in the challenge to create a sustainable future in terms of transport, the distribution of goods and services (e.g. water management), but they will also help provide greater territorial and hydrogeological protection.

TUNNELS, UNDERGROUND RAILWAY LINES, SEWAGE NETWORKS: THE BEST ITALY HAS TO OFFER IN UNDERGROUND WORKS

This issue’s “Teamwork” section is focused on Vaga, a company that joined Mapei in 2000 and has 80 years’ experience in the extraction of sand and the manufacture of building materials with constant focus

on product research and sustainability (sand, building mortars, materials for sports facilities). Among all the numerous projects that the Group has always supported (from social responsibility to sport) a special place goes to the Alla Grande sailing venture, a transoceanic voyage that set sail from France for Guadeloupe at the beginning of November with Mapei’s colours proudly displayed on the sails of the boat “steered” by Ambrogio Beccaria, who finished second.

Enjoy your reading

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Cover story
The focus of this issue of *Realtà Mapei International* is on Mapei solutions for tunneling and underground works, including those on sewer systems. The photo shows waterproofing membranes applied in a tunnel of the Farringdon Station in London.

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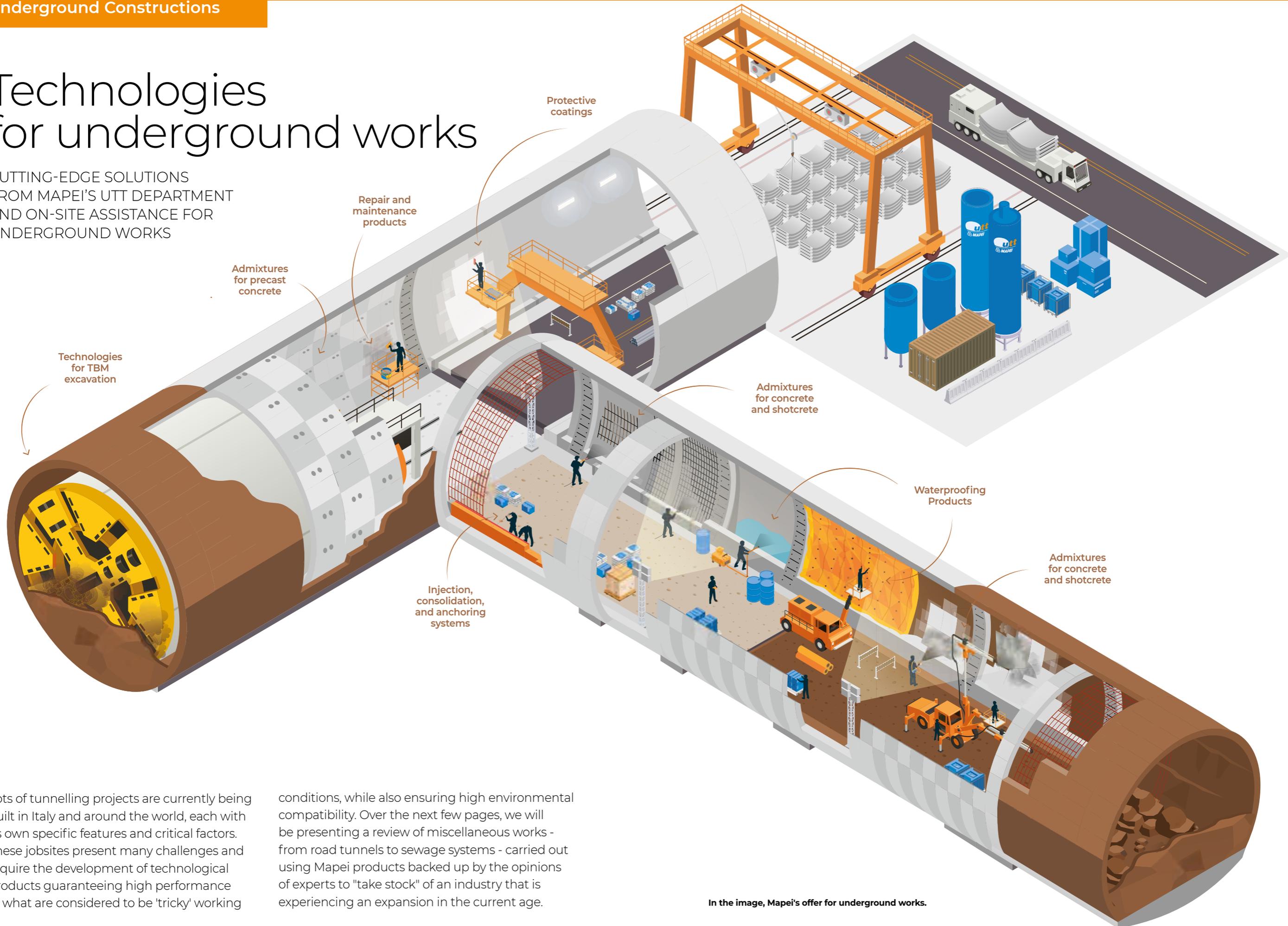
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Technologies for underground works

CUTTING-EDGE SOLUTIONS FROM MAPEI'S UTT DEPARTMENT AND ON-SITE ASSISTANCE FOR UNDERGROUND WORKS



Technologies for TBM excavation

Admixtures for precast concrete

Repair and maintenance products

Protective coatings

Admixtures for concrete and shotcrete

Waterproofing Products

Injection, consolidation, and anchoring systems

Admixtures for concrete and shotcrete

Lots of tunnelling projects are currently being built in Italy and around the world, each with its own specific features and critical factors. These jobsites present many challenges and require the development of technological products guaranteeing high performance in what are considered to be 'tricky' working

conditions, while also ensuring high environmental compatibility. Over the next few pages, we will be presenting a review of miscellaneous works - from road tunnels to sewage systems - carried out using Mapei products backed up by the opinions of experts to "take stock" of an industry that is experiencing an expansion in the current age.

In the image, Mapei's offer for underground works.



by Enrico Dal Negro

Our role as tunnelling and excavation facilitators

THE STRATEGY OF THE GROUP FOR THIS SECTOR IS TO COMBINE EFFECTIVE APPLICATION WITH ENVIRONMENTAL COMPATIBILITY

When was the Mapei UTT line created and how has it grown over the years?

The UTT Business Unit was created in September 1999, the year I joined Mapei. Initially it consisted of products already in the company portfolio with a cross-section of areas of use and applications, and then it was gradually extended with the introduction of specific products to support excavation and completion of each work. The first project we worked on was the renovation of the Mont Blanc tunnel following the fire in March 1999. This was a very important project, one in which we were given the opportunity to demonstrate the versatility and reliability of our products, many of which were developed in a very short space of time. The line today is more complete and is gradually being extended with new products, driven by our intuition and the demand from both the mechanised tunnelling and traditional excavation markets.

“ Mapei is present on the most important sites currently open in Italy: from High-Speed rail projects to the Brenner tunnel and the 106 Ionica highway

What important projects is Mapei currently working on?

In Italy we are involved in many projects, thanks also to the national investment plan for the coming years in both renovation work and new construction projects. We are working on High-Speed rail projects – such as the third Milan-Genoa link and the Naples-Bari and Catania-Messina stretches – the Brenner base tunnel and the 106 Ionica highway. Overseas, we have done a lot of work in

Norway and Northern Europe as a whole. We have also seen considerable growth in Canada and the United States, we are constantly working on projects in South America and we are also starting to see more growth in Australia. As far as Asia is concerned, we work a lot in Singapore and Hong Kong in particular and we are also seeing strong growth in India. The projects we work on are quite diverse, from underground railways to mines, from rail tunnels – a sector undergoing particularly strong growth for environmental sustainability reasons – to road tunnels, hydraulic tunnels and sewer systems.

How much attention is paid to the environmental compatibility of Mapei UTT products? Can you give us some examples?

Environmental compatibility is a fundamental characteristic of our products. We realised right from the start that this aspect would be particularly important for the market and we made very quick progress, including with respect to our competitors, and were the first to establish a reference standard, especially in the field of soil conditioning for TBM excavation works, a sector in which the need for eco-sustainable products is particularly important. We managed to combine high performance products and respect for the environment, something that is not always easy to achieve, and this has led to us building trust with our clients. For example, we have the POLYFOAMER ECO family of foaming agents, which over the last few years has developed from POLYFOAMER ECO 100 to POLYFOAMER ECO 100 PLUS and then POLYFOAMER ECO 1000 PLUS, with a progressive improvement in environmental performance characteristics. We can also say the same for all the products from the line that now come with WGK (Wassergefährdungsklasse) certification, which evaluates the impact a product has on groundwater and classifies the risk of contamination on a scale of 1 to 4,

“ We realised right from the very start of operating in this sector that environmental issues would be important for the market and managed to get a head-start on our competitors

with all our products having a rating of between 1 and 2.

The durability of structures has become a very important topic: what is the approach to this concept across this product line?

As far as durability is concerned, it is very important that products are used and applied correctly. In Mapei, we have the possibility of offering high level solutions that are able to minimise their impact in the event of poor use – often because of the difficult environments where the actual work is being carried out – and guarantee, nonetheless, proper durability. Nowadays, large-scale projects are required to have a service life of at least 100 years, apart from a few exceptions, such as the Brennero tunnel, where a service life of 150 years is required. This long arc of time is due to the high cost of building and repair projects, and also the desire to minimise their social impact, because interrupting a service provokes considerable disruption for its users.

Innovation and research are cornerstones of Mapei: what are your most recent and cutting-edge products from a technological perspective?

Undoubtedly the products from the POLYFOAMER ECO family of foaming agents, and also the admixtures for concrete, which focus on maintaining the concrete's high performances while looking to reduce cement consumption. With our products we try to reduce their impact on the environment to a minimum, and by “low impact” we mean not only low emission of CO₂ during the production phase, but also less impact at the moment they are actually applied. And it is here that chemistry is an enormous help in making products more sustainable. In this sense, it is worth remembering that chemistry is not synonymous with pollution, but rather with research, development and the possibility of making people's lives easier in a sustainable way.



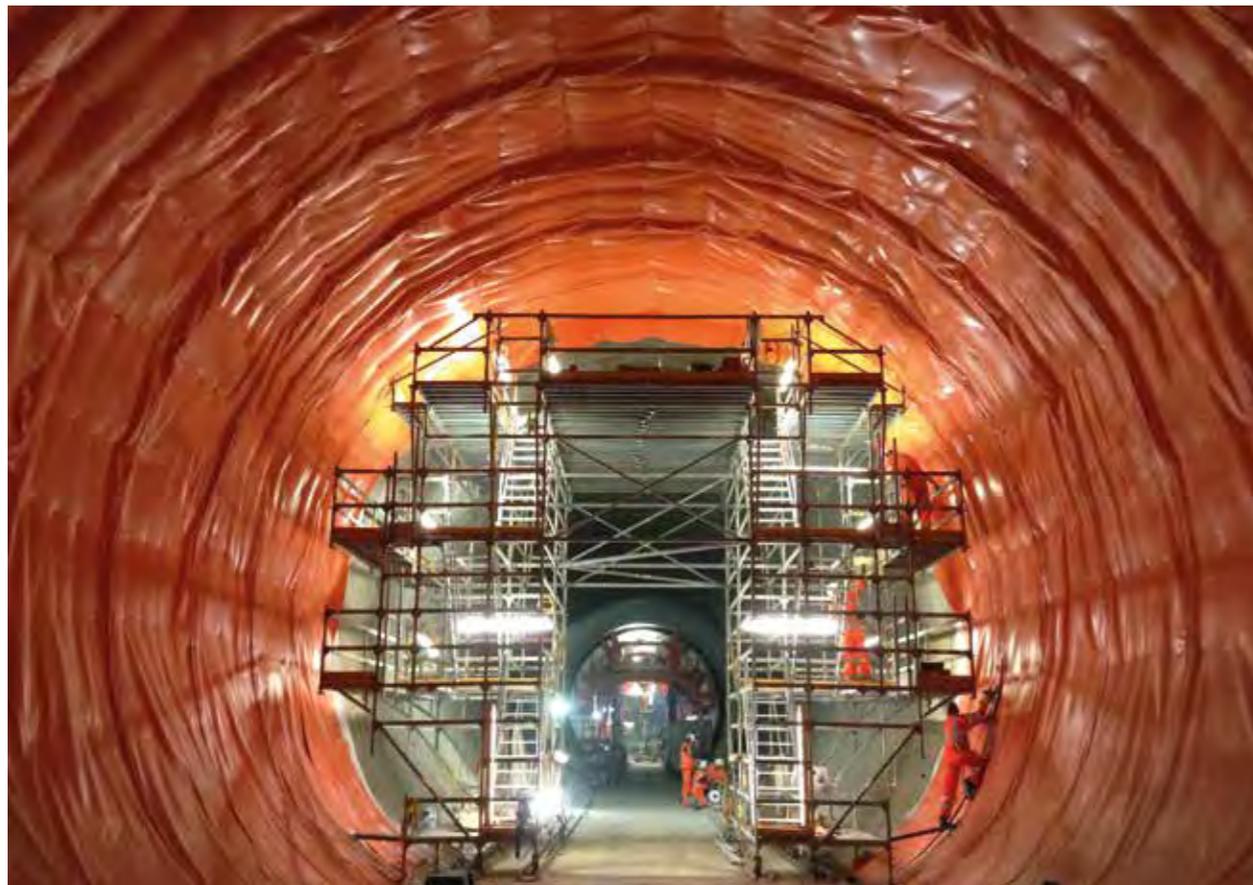
Mapei products and technical support contributed to the completion of the Isarco River underpass at Brenner base tunnel (top of the page) and the A1 motorway var tunnel (above).

“ We have a consolidated position in Norway, we are growing in North America and we are particularly active in India and South East Asia

What type of site support can the UTT group provide?

Our support service, which we call Technical Service, starts at the preliminary laboratory phase where we carry out a series of tests based on real site conditions to identify our best proposal to meet the requirements of a particular project. We propose our most suitable products along with their relative dosage rates and application parameters. Once we have been awarded a contract, we go over the tests and parameters again to define certain fine details where required. We then pass to the application phase: we are also present during this phase to make sure a product is used correctly and in the best way possible. We follow sites during each and every phase. The technical service is an important element with highly skilled personnel at the service of clients, who also have ability to develop, if and when necessary, bespoke proposals for a specific site.

Director, UTT line, Mapei Group



Mapei Group's waterproofing membranes were used during tunnelling works at Farringdon Station in London (UK).



by Daniele Peila

Engineering ability and creativity: the high profile of Italian knowhow

ALL AROUND THE WORLD ITALIAN TUNNELLING EXPERTS HAVE DEMONSTRATED UNRIVALLED EXPERTISE AND FLEXIBILITY WHEN OVERCOMING VARYING AND UNPREDICTABLE UNDERGROUND CONDITIONS

Italy boasts a high level of technological expertise in the underground works sector. Where does this globally acknowledged know-how come from?

To answer this question, we have to take a look into our history. We have to go way back to the extraordinary engineering ability of the ancient Romans who constructed a large number of hydraulic and road tunnels, an unbelievable achievement considering the era in which they were built. These works highlight their unrivalled engineering ability and “creativity” in overcoming the technical difficulties of working underground using only the tools and knowledge of that time. And then we shouldn't forget that Italy, because of its topography and chain of mountains separating it from the rest of Europe, has had to make “a virtue out of necessity”, digging tunnels in order to create an efficient transport system both of railway and of road. The first “modern” tunnel in the world was, undoubtedly, the Frejus railway tunnel, so strongly desired by Italian first prime minister Camillo Benso, Count of Cavour, who, when addressing the Parliament during the debate to approve legislation to finance the project, declared: “Gentlemen, the undertaking we are proposing, there is no denying, is gigantic. Its execution, however, must be achieved for the glory and benefit of the country. I trust you will crown your work with the greatest of all modern undertakings and deliberate on the tunnelling at Moncenisio.” In the nineteenth century, the need to “connect the nation” by means of an adequate railway network meant that a large number of tunnels also needed to be constructed, in a very short space of time, in the complex and difficult terrain of the Apennine Mountains extending along the length of the Italian peninsula. For the construction of the motorway network after the Second World War, so many new and ambitious tunnels had to be constructed that Italy

became the leading country in Europe in terms of the number and length of road tunnels. This historic journey helped forge a generation of highly skilled engineers and craftsmen directly in the field, “knowhow” that was gradually passed down and, thanks to which, demonstrated to the world our unrivalled expertise and flexibility when overcoming often varying or unpredictable underground “geo” conditions. And we mustn't forget Italian universities, which have always turned out quality technicians and engineers: since 1967 Politecnico di Torino has held a “Tunnel Construction” course and we have always had a first rate university system.

“ Long, deep tunnels are the ones that now represent the frontier in tunnel construction

What are the most significant ongoing works in Italy and around the world? Which large-scale sites are Italian companies working on?

At the moment there are so many tunnels under construction around the world that it would be practically impossible to answer this question without leaving something out. Also because, for those like me who work on tunnel construction from a scientific perspective, the most challenging projects are not necessarily the most “ostentatious” ones, but those where specific criticalities need to be tackled. The challenges we are coming up against range from extremely deep tunnels, which means enormous loads from rock formations and the difficulty in carrying out preliminary investigations, to tunnels with larger and larger diameters to meet the needs of modern transport systems, to tackling increasingly high water heads and

to overcoming increasingly complex and heterogeneous geological conditions. If I had to summarise, long, deep tunnels are the ones that represent the frontier in tunnel construction. In Italy we have two of the largest projects in the world currently under construction: the Brennero tunnel between Italy and Austria and the Moncenisio tunnel between Italy and France, without forgetting the tunnels along the third Milan-Genoa link or those along the High-Speed railway line between Naples and Bari, or the large railway projects included in the National Recovery and Resilience Plan (PNRR) which features the construction of an incredible number of tunnels.

The Italian PNRR includes investments into sustainable mobility. Is this an occasion to build new infrastructures and complete those already under construction?

The scheduled large-scale projects to boost the Italian High-Speed rail network includes the construction of an incredible large number of tunnels in really challenging ground and geological conditions that will really put designers to the test, as well as the construction companies contracted to construct them. The use of full-section TBMs will be boosted and driven to levels we could never even have imagined before now here in Italy. Speaking as a professor, however, I must underline my concerns from a human perspective. Universities only manage to turn out a few engineers and technicians specialised in this sector. Youngsters tend to choose professions more in line with modern times, forgetting how fascinating the “concreteness of construction” can be. It is certainly a job that requires sacrifice, but it is up to the construction companies business world to highlight its attractions and give it the importance, including social, it had in the past.

What cutting-edge materials and techniques have been developed in recent years for digging tunnels and conditioning the ground?

The use of full-section TBMs, especially when operating in EPB mode, has become incredibly more widespread because of the numerous advantages of using this technology. In recent years Italy has placed a lot of emphasis on environmental issues in the construction industry, with the introduction of very advanced legislation in the sector covering ground and rocks from tunnelling work. To meet the requirements of these specifications it became necessary to develop cutting-edge products and surveying methods and this development has also involved universities and the Italian Research Council. It is important to emphasise how conditioning ground and rocks in EPB technology is one of the sectors in which, in the last few years, scientific research has shown to be more “effervescent” to get both a better understanding of the mode of operation of conditioning agents perfected by both industry and the laboratories of various universities, such as the Colorado School of Mines, Politecnico di Torino and the University of Ruhr, and to develop increasingly environmentally sustainable products with higher rates of biodegradability and very low eco-toxicity. I would like to underline, however, that to carry out adequate experimentation during the design phase and while work is ongoing, laboratories with considerable expertise and knowhow are required due to the delicacy and sensitivity of the tests to be carried out. This aspect is often overlooked by those who construct tunnels.

What lines of research are open at the moment and which will be opened as we look towards the future?

The complexity of problems related to tunnelling work,

and with long, deep tunnels in particular, has stimulated research work, with researchers now required to provide their contribution on how to investigate and interpret geological formations at great depths; predict and simulate the behaviour of rock masses encountered at great depths subjected to high lithostatic pressure; predict and manage underground seepages; improve technology, essentially of TBMs, in order to tunnel quickly and control deformation in rocks and the ground and, as and when required, cope with seepages of water under high pressure; improve ground conditioning and retro-injection procedures; improve safety for the operators; guarantee a sufficient service life for structures; and lastly, preserve and protect the environment.

“ **Research plays an increasingly decisive role. This includes studies on the handling and management of excavated materials, with a view to reusing them as part of the virtuous journey towards a circular economy** ”

Larger and larger machines are now able to operate successfully and with high performance in increasingly complex natural rock masses (heterogeneous, hard and abrasive with water under high pressure) thanks to the technological evolution of mechanical engineering, information technology, chemistry and robotics, and thanks also to the ability to investigate, with pretty good reliability and in relative safety, the behaviour of natural rocky masses that will be encountered ahead of the machine.

I would also like to say a few words on the complex issue of maintenance work on structures coming to the end of their service life. This is an increasingly important topic that will require, on the one hand, enormous resources, while, on the other, far from banal engineering skills to manage old infrastructures.

In the management of environmental issues when constructing infrastructures, which also means tunnels, we have seen enormous progress and a vast amount of scientific research. And from all this research, it would be remiss of me not to mention the studies carried out on the handling and management of excavated materials, with a view to reusing them as part of the virtuous journey towards a circular economy. Research at international level is focusing a great deal of attention on quantifying the “carbon footprint” of the various construction phases of large-scale infrastructures, and specific focus is being concentrated on energy efficiency in processes involving not only TBMs, which must strive to become “green TBMs”, but also on the entire energy

consumption chain (belt conveyors, ventilation systems, etc.). And lastly, we should not forget the in-depth work being carried out to raise the quality and durability of tunnel coverings and linings.

Collaboration between companies and universities has become increasingly important in the development of innovative products. What is your appraisal of current initiatives and of those moving forward?

Collaboration between companies and universities has become more important than ever, for both parties. For example, the relationship between Mapei SpA and Politecnico di Torino in the ground conditioning sector and in two-component grout products goes back 15 years: we have developed procedures, tested products and carried out in-depth experiments which has led to, on the one hand, far greater expertise in the entire world of infrastructures, in that certain tests and testing methods have become normal practice, while on the other it has enabled the quality of products to be improved. In parallel, choosing the “right” TBM with the correct equipment, one of the key points in designing and then constructing tunnels, means that the work of researchers, designers and those who build the machines will need to be integrated in order to find and test increasingly efficient, safe and innovative solutions. And then, obviously, the capacity to carry out preliminary investigations to give both the indications required to quantify the feasibility of the work and to describe, from a quantitative perspective, the mechanical characteristics of the rocky masses to be passed through. Finally, the Universities has the great responsibility to prepare good engineers that will be able to take the lead in the industry.

Full Professor for Tunnelling and Director of the Post-graduate Master Courses at Politecnico di Torino

DANIELE PEILA

Daniele Peila is presently Full Professor at Politecnico di Torino teaching “Tunnelling” and Director of the Post-graduate Master Courses: “Tunnelling”, “Highway Engineering and Integrated Road-Network Management” and “Sustainable Design in Geo-Engineering and Tunnelling Works”. He is responsible of the laboratory for Tunnelling and Rock Engineering at Politecnico di Torino. He was Vice-President of International Tunnelling and Underground Space Association and has been acting as Vice-president Italian Tunnelling Association since 2013. He was also a member of the Executive Board of the Geoengineering and Environment Association for 10 years. He was awarded the “Colombo lecture” prize for 2022, a recognition that the Italian Tunnelling Society gives tunnel experts each year.



Consolidation tests are carried out in the Laboratories of the Politecnico di Torino.

“ **The use of full-section TBMs will be boosted and driven to levels we could never even have imagined before now in Italy** ”



Milan (Italy)

M4 Metro Line

ADMIXTURES FOR CONCRETE, WATERPROOFING MEMBRANES AND PRODUCTS TO INSTALL CERAMIC TILES AND STONE MATERIALS FOR A NEW METRO LINE FOCUSED ON SUSTAINABILITY



58 years after inaugurating Milan's first underground railway line, six stations opened their doors this year on 26th November to passengers travelling on the city's new line, the fifth in chronological order. Once completed (at the end of 2024), the M4 Line, or Blue Line, will connect the old city centre to the eastern part of the city (the Forlanini district and Linate Airport) and to other districts to the west (Lorenteggio and San Cristoforo railway station).

The new line will carry a rapid, comfortable light-railway service with the latest safety features: in fact, the automatic, driverless trains are equipped with an intelligent traffic-control system to ensure passengers enjoy their journey in complete safety.

Once completed, the line will have a capacity of 24,000 passengers every hour in each direction, thanks also to the frequency of trains that, at peak times, will pass every 90 seconds. In mobility terms, the M4 will have quite an impact on the city: with this line coming into service, the underground rail network will have a total length of 118 km, making it the sixth longest infrastructure of its kind in Europe.

A sustainable project

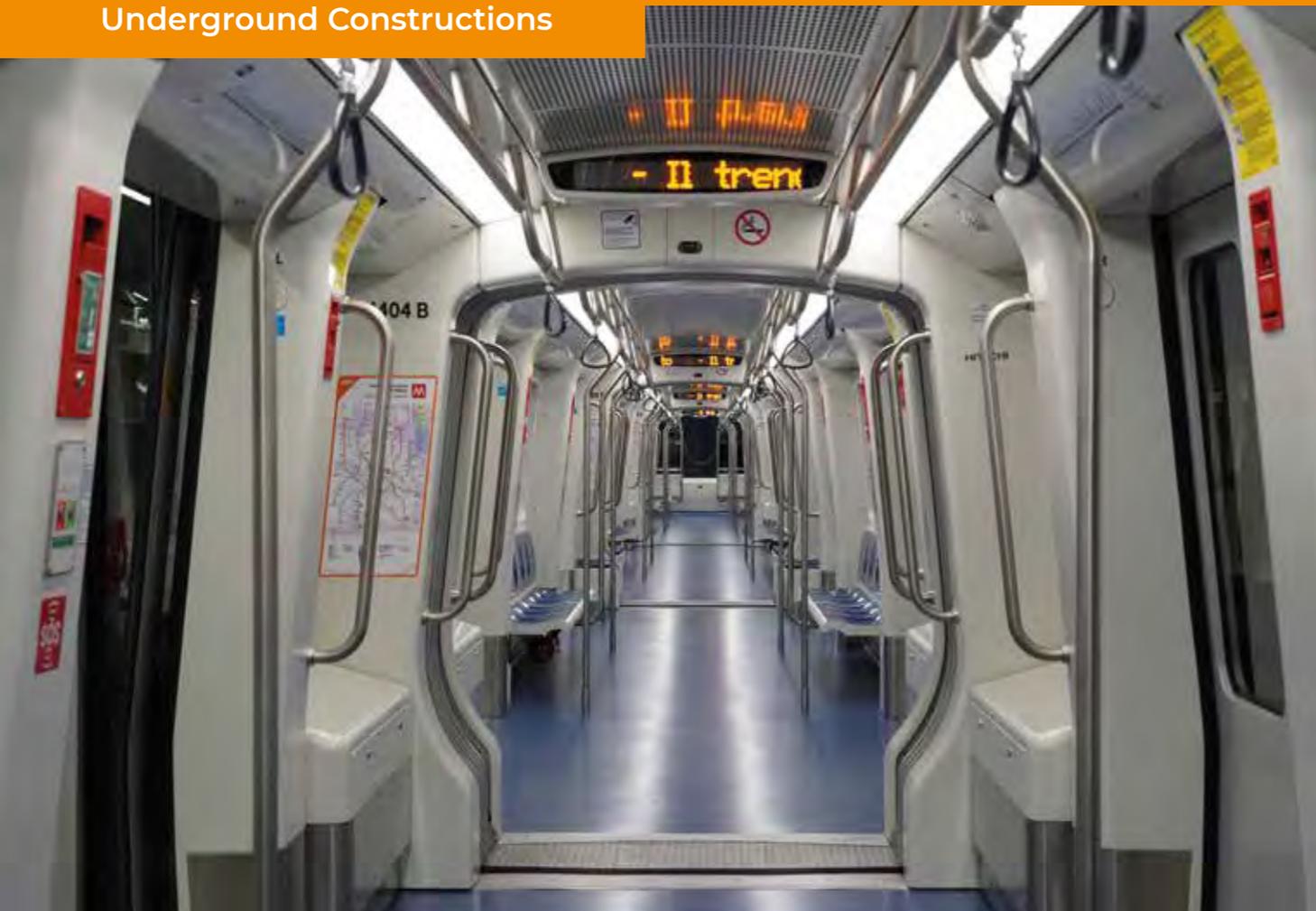
The underground rail line has zero emissions and will have a positive impact on road traffic by encouraging the use of public transport, with considerable benefits for both the environment and for those who live and work in Milan. In fact, the new M4 and M5 lines (the latter was opened between 2013 and 2015) will reduce the number of car journeys by around an estimated 30 million per year and carbon dioxide emissions by around 2%.

The M4 Line is being excavated underground along "blind" tunnels using TBM technology, apart from the "open air" excavation work for the stations, service systems and other structures. The construction phase is also heavily focused on environmental sustainability: non-polluting, non-toxic and non-hazardous products are being used to consolidate the soil and to ensure tunnelling operations advanced as scheduled.

Mapei's contribution: admixtures for concrete

Mapei started to supply concrete admixtures for the M4 in 2013 when preparation work got underway and retaining walls were built where the ground was being excavated for the construction of the stations.

Concrete admixed with DYNAMON XTEND W400R was



Figures for the M4 Metro

15 km
LENGTH OF THE LINE

21
NUMBER OF STATIONS

86 million
PASSENGERS PER YEAR
(EXPECTED FIGURE)

80 km/h
MAXIMUM SPEED

6.5 m
DIAMETER OF TUNNELS
EXCAVATED IN THE EXTERNAL
SECTIONS

9.15 m
DIAMETER OF TUNNELS
EXCAVATED IN
THE CENTRAL SECTION



ABOVE. The Mapei Group supplied concrete admixtures and waterproofing membranes for the M4 line.

IN THE FACING PAGE

The new M4 line will carry a rapid, comfortable light-railway service with the latest safety features and a capacity of 24,000 passengers every hour. In the previous pages: ceramic and stone floorings were installed in the stations with Mapei products.

used for this phase and made by Monvil Beton. In a following phase of the works, concrete was produced by Holcim, Colabeton and Betonrossi using the latest generation of Mapei admixtures, such as the acrylic super-plasticisers DYNAMON XTEND W300 N and DYNAMON XTEND W300 R. The same admixtures were also used in the construction of the support bases for the tracks. Mapei is also currently supplying products to repair and restore the roads and piazzas around the stations.

SILEX P9 EXPRESS high performance rapid-setting cementitious adhesive, while ULTRALITE S2 FLEX one-component, highly-deformable, lightweight cementitious adhesive with extended open time was used to install the thin porcelain tiles on the walls. The joints were grouted with ULTRACOLOR PLUS mortar and the expansion joints were sealed with MAPESIL LM and MAPESIL AC silicone sealants, used for ceramic and stone coverings respectively.

Waterproofing membranes

MAPEPLAN TU S, MAPEPLAN TT D, MAPEPLAN WATERSTOP and MAPEPLAN PROTECTION synthetic membranes were used to waterproof the foundations of numerous stations (San Cristoforo, Gelsomini, Segneri, Tolstoj, Washington Bolivar, De Amicis, Vetra, Santa Sofia and San Babila), along with POLYFOND KIT drainage system, MAPEPLAN INJECTION VALVE and IDROSTOP MULTI PVC-P re-injectable hoses. These products are all manufactured by Polyglass SpA, a subsidiary of the Mapei Group.

Protective finishes

The surfaces ventilation shafts located at the exits of the stations were protected with WALLGARD GRAFFITI BARRIER graffiti-resistant, reversible protective coating and painted with ELASTOCOLOR WATERPROOF easy-to-clean, waterproof acrylic paint.

Vaga's contribution

Vaga, a subsidiary of Mapei Group (see articles dedicated to this company in this issue of the magazine), supplied HR15 high strength, fire-resistant cementitious mortar and INTO+FIBRO fiber-reinforced rendering mortar.

Installing ceramic and stone floor and wall coverings

Before installing the stone and ceramic floorings in the stations, the screeds were repaired where required with EPOJET two-component epoxy resin. Waterproofing work was carried out using MAPELASTIC TURBO two-component cementitious mortar. The product chosen to install the diorite paving was ADE-



Find out more
MAPEPLAN TU S



Find out more
ULTRALITE S2 FLEX

TECHNICAL DATA

Metro M4 Line, Milan
Period of construction: 2013-ongoing
Period of the Mapei intervention: 2013-ongoing
Owner: MM SpA
Works direction: M4 SpA
Contractors: We Build Group, Astaldi, Hitachi Rail, Sirti
Waterproofing contractor: Tecnomanto srl
Ceramic installation

contractor: Ettore Bosisio srl
Concrete production: Holcim, Colabeton, Betonrossi, Monvil Beton
Mapei coordination: Luca Pretini, Andrea Siboni, Alessio Riso, Mapei SpA; Mapei UTT Technical Services

MAPEI PRODUCTS
Concrete admixtures: Dynamon XTEND W300 N, Dynamon XTEND W300 R, Dynamon XTEND W400 R

Waterproofing: Idrostop Multi, Mapelastic Turbo
Concrete repair: Epojet, Mapegrout Thixotropic, Mapefer 1K
Installing ceramic tiles: Adesilex P9 Express, Ultralite S2 Flex
Grouting tile joints: Ultracolor Plus
Sealing expansion joints: Mapesil LM, Mapesil AC
Wall coatings: Wallgard Graffiti Barrier, Elastocolor Waterproof

POLYGLASS PRODUCTS
Waterproofing products: Mapeplan Waterstop, Polyfond Kit, Mapeplan Protection, Mapeplan Injection Valve, Mapeplan TU S, Mapeplan TT D

VAGA PRODUCTS
HR15, Into+Fibro
For further info: mapei.com, utt.mapei.com, polyglass.com, vaga.it



by Massimo Stefanoni

Polyfoamer Eco Line

SOIL CONDITIONING ADMIXTURES COMBINE TECHNICAL AND ENVIRONMENTAL PERFORMANCES DURING EPB-TBM WORKS

The importance of a rapid and safe advance rate with EPB (Earth Pressure Balance)-type TBMs (Tunnel Boring Machines) is well known to the whole of the global tunnelling industry. Less well known however, or certainly less discussed in the literature available, are the issues regarding the environmental impact of admixtures used to condition excavated soil. In fact, chemical products added to the soil during tunnelling inevitably have a certain degree of impact on both soilwater and on the soil excavated.

Even at low concentrations many chemical substances can trigger harmful changes to the chemical balance in the soil, but it is also true that, with the quantities generated during the tunnelling process (for instance, with a 40 km tunnel an estimated 2.5-3.0 million m³ of excavated material would be produced), even substances considered generally as low contaminants could have quite a heavy environmental impact with negative effects on the survival and/or reproduction cycle of organisms. When considering products with similar performance properties, the level of impact they have on the environment depends on the chemical formulation of the conditioning agents. Over the years a number of innovative products have been developed and the aim of this article is to illustrate how the performance balance between technical and environmental considerations has been improved.

“Sustainable conditioning” means:

- reducing environmental impact without negatively impacting tunnelling performance;
- avoiding having to treat conditioned material as waste;
- avoiding costs associated with the disposal of the material;
- reusing excavated material, thereby accelerating its transportation to the site where it will be definitively deposited.

The importance of conditioning soil from a technical perspective

Soil conditioning is a “key factor” for a rapid, safe advance rate of a TBM, and has a significant influence on the overall performance of a TBM and on the entire project.

The actual cost of conditioning agents is minimal when compared with the total cost of a project, but their impact can be enormous, in that the quality of these products has a very high influence on TBM performance: advance rate, reduction in downtimes, wear to the cutting tools, energy consumption, etc.

The chemical product most commonly used for conditioning soil is a foaming agent which, when mixed with water and air, generates foam that is injected at the tunnelling front, into the TBM chamber and along the screw-type extraction conveyor, where it is mixed with the soil to “improve” its consistency. The desired effect of the foam depends on the soil excavated. In the case of granular soil, the foam needs to “aggregate” the soil, creating a plastic-consistency paste that can be used to apply EPB pressure at the tunnelling front and, where required, minimise the risk of “uncontrolled” ingress of water into the tunnelling chamber. In the case of cohesive soil or rock formations (clay, slate, etc.), conditioning serves to minimise the risk of clogging, or material sticking to the metal components of the machine which could then lead to slowing down tunnelling operations or even lengthy downtimes, with economic repercussions due to a loss in production, or safety issues.



ABOVE. The excavated material is transported outside the EPB-TBM by a belt conveyor.

Managing and handling conditioned soil

Adding a chemical product to soil as the EPB advances leads to a certain degree of impact on the environment: on soilwater (if tunnelling is below the water table) and on the soil extracted (muck), which will contain a certain amount of the conditioning agent and will need to be transported away from site to a place where it can be definitively deposited. The degree of impact depends on the formulation of the conditioning agent: different foaming agents do not only lead to different performance properties, but also to different biodegradation rate and different levels of toxicity in the muck. How this material is classified (by-product or waste), and how long it can be stored on site has an enormous impact on the entire tunnelling project.

For around the last ten years, particular attention has been paid to how muck conditioned with foam is managed on Italian TBM tunnelling sites. This issue has been arousing growing interest all the world over.

Environmental tests on conditioned soil were carried out by internationally renowned institutes such as Politecnico di Torino, CNR (Italian National Research Council) and the Mario Negri Institute of Pharmacological Research which have come to the same conclusion: muck needs to be temporarily stored on site for a certain period of time in large storage tanks until its impact on the environment due to adding the conditioning agent is either annulled or drops below a certain limit accepted by regulatory bodies. Only in that moment may the storage tanks be emptied and the muck transported to the site where it will be definitively deposited.

The checks that need to be carried out before emptying the storage tanks on site generally regard the following:

- The eco-toxicity of the muck: the conditioned soil may only be transported away from site when it is no longer toxic to certain organisms;
- The presence of surfactants in the muck or in the eluate they are in contact with: the conditioned soil may only be transported away when the concentration of surfactants is lower than a prescribed limit.

The size of the storage tanks on site needs to be calculated during the design phase and, as such, can significantly influence the project, in that the tunnelling advance rate depends on them. Besides, it is not always possible to have spacious storage tanks, especially when tunnelling in urban environments. So this an important detail that could slow down TBM activity or even bring it to a halt while waiting for environmental parameters to be reached.

Products for conditioning soil sustainably

The use of a product with rapid degradation capacity and a low eco-toxicity index inevitably leads to a reduction in waiting times before the soil inside the storage tanks reaches the required environmental limits. To meet the need to optimise muck handling and man-

agement, Mapei Research has developed a series of innovative foaming agents: the POLYFOAMER ECO line. These products are characterised by eco-toxicity indices, certified by independent laboratories, which are several orders of magnitude lower than traditional foaming agents. Site conditions can further increase these differences compared with those obtained under laboratory conditions. Degradation of the surfactant within the muck and its toxicity are influenced by numerous factors such as the surrounding temperature and humidity in the area where the storage tanks are located, unforeseen geological variations, variations in the amount of foam required for tunnelling, possible bacterial contamination, etc.

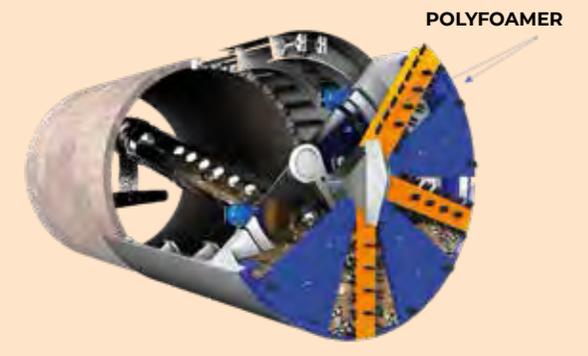
Products from the POLYFOAMER ECO line, such as POLYFOAMER ECO 100 and POLYFOAMER ECO 100 PLUS, have already been used in the construction of more than 40 km of tunnels, both in Italy and abroad, showing that “sustainable conditioning”, as explained previously, is becoming a concrete concept.

The development of these products has improved the balance between technical performance and environmental impact, clearly showing that it is possible to bore tunnels efficiently and, at the same time, optimise the handling and management of muck.

Building Lab, Research & Development, Mapei SpA (Italy)

EPB-TMB

Earth Pressure Balance, or EPB, is a mechanized tunneling method in which the excavated material is used to support the tunnel face while it is being plasticised using foam/slurry & other admixtures to make it transportable and water-proof. The excavated material is transported into the Tunnel Boring Machine (TBM) via a screw conveyor which allows the pressure at the face of the TBM to remain balanced without the use of slurry. EPB TBM are mainly designed for soft soils containing water under pressure. The EPB TBM can handle loose sedimentary deposits with large boulders and high water table. The excavated material is transported by a screw conveyor from the excavation chamber to the belt conveyor. The combination of the output of the screw conveyor and the advance rate of the TBM ensures that the support pressure in the excavation chamber can be exactly controlled.



Buenos Aires (Argentina)

Matanza-Riachuelo Basin

TECHNICAL AND ENVIRONMENTAL CHALLENGES FOR TUNNELLING WORK USING EPB-TBM TECHNOLOGY



View of an external section of the Matanza-Riachuelo Basin Lot 3.

The Sustainable Development of the Matanza-Riachuelo Basin-Lot 3 project is part of a vast hydraulic plan of works developed in Buenos Aires to treat wastewater and then discharge it into River Rio de la Plata to increase the sewer capacity of this metropolis with a population of 14 million. Lot 3 is divided into three parts: the main upstream wells going down to a depth of 50 m, a 12 km-long sub-fluvial discharge tunnel and 34 risers. The 12 km tunnel was bored out using an EPB (Earth Pressure Balance)-TBM (Tunnel Boring Machine) with a diameter of 5.2 m in particularly complex geotechnical and hydrological conditions. This can be considered one of the most complex tunnelling projects in the world because of its geographical location and the technical challenges encountered on site. The excellent collaboration between the contrac-

tor's staff and the Mapei UTT team enabled the challenges of the project to be successfully overcome, from production of the segments to soil conditioning and injection of materials for TBM operations. Thanks to the use of POLYFOAMER ECO 100 PLUS, it was possible to minimise the impact of the project on the conditioned soil while also promoting its re-use as a by-product.

Environmental challenges

The design and construction phases of the discharge tunnel were characterised by numerous technical challenges and environmental restrictions because of the project's configuration and geographical location. The geology around the site of the tunnel is comprised of sand and clay deposits. Going into detail, the geological for-

mations encountered were:

- Puelche-type formations: highly permeable, mainly mono-granular sand-based deposits;
- Post-Pampean formations: particularly soft clay and silt formations.

The tunnel was mainly bored out through Puelche-type formations, the characteristics of which presented a particularly difficult scenario in terms of both soil conditioning and the injection of fillers. The main significant benefit of this project is that the sewer pipes do not discharge into River Riachuelo (also called "Rio Matanza") and later on into Rio de La Plata, which means a reduction in the amount of pollution. To support this initiative, special chemical products had to be chosen to minimise the impact that the construction of the tunnel would have on the environment.

Technical challenges

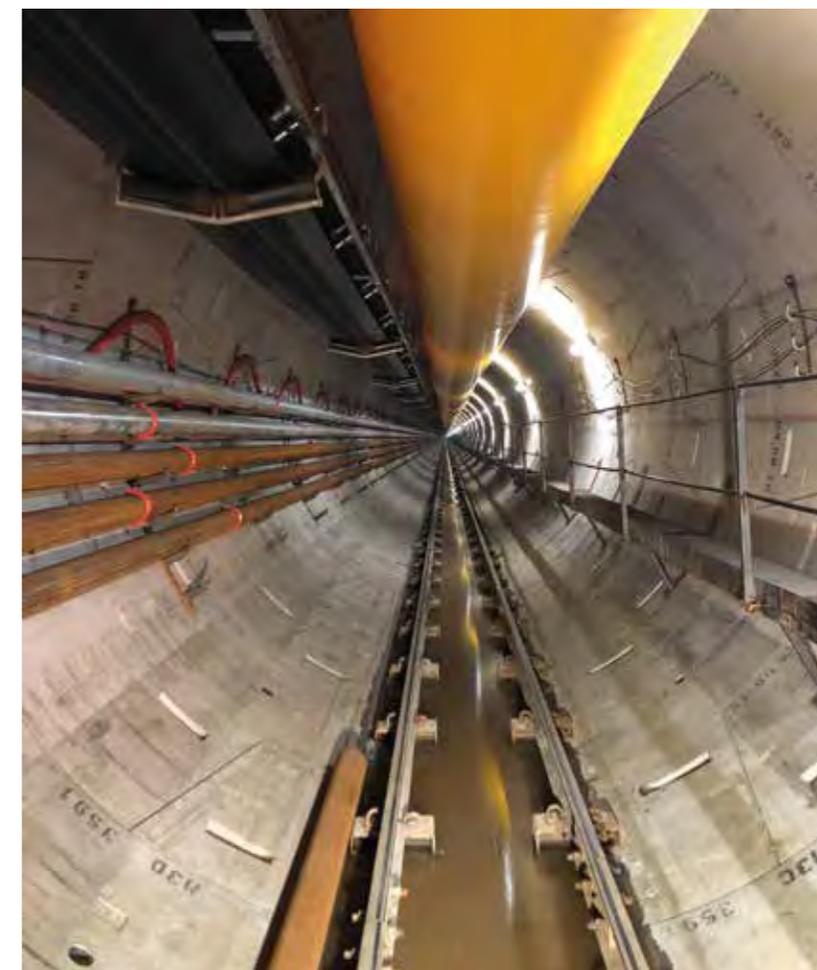
During construction of the entire discharge tunnel, the TBM had to operate under a counter-pressure of more than 4 bar, very close to the limit of EPB technology. To meet this critical design requirement, the foaming agent used to condition the soil, and the parameters adopted for its application, played a key role in the success of the TBM operations. The lining for the tunnel had a number of critical aspects: high net internal pressure, peak flow speeds of more than 25 m³/s, service life of more than 100 years, etc.

As a result, production of the segments and development of the mix-design for the concrete were extremely important aspects for the final quality of the lining.

Conditioning soil with POLYFOAMER ECO 100 PLUS

Right from the initial phases of the project, the Mapei Underground Technology Team (UTT) worked in close collaboration with the design engineers and main contractor to choose the most suitable solutions for the project and provided technical support to help manage tunnel construction operations.

The foaming agent POLYFOAMER ECO 100 PLUS was chosen to condition the soil during the EPB-TBM tunnelling operations and it was successfully used for the entire progress of the tunnel, through both the Puelche sand formations and, again, when the areas in clay and silt were encountered. The use of POLYFOAMER ECO 100 PLUS is an important innovation in the soil conditioning sector, thanks to its low toxicity and rapid biodegradation. By using and varying the parameters



The inside of the excavated tunnel was covered with concrete segments.

AVERAGE TBM PERFORMANCE DATA DURING TUNNEL EXCAVATION WORKS

PARAMETERS	AVERAGE VALUES
Advance speed	65 – 85 mm/min
Thrust force	11 – 13 MN
Cutter head torque	1.2 – 2.0 MN/m
Cutter head rotational speed	2.3 – 2.7 rpm
Screw conveyor working pressure	50 – 80 bar
EPB pressure at the face	Up to 4.5 bar in the crown
consumption of POLYFOAMER ECO 100 PLUS	20 – 30 l/advance

TOXICITY TO ALGAE (OECD 201)



Comparison of the toxicity to algae of POLYFOAMER ECO 100 PLUS and two traditional foaming agents according OECD 201 standard.

for this product, it was possible to maintain a high rate of advancement with TBM operations in all the geological conditions encountered. Thanks to the extremely low environmental impact of POLYFOAMER ECO 100 PLUS, the soil removed was then re-used as filler material at an industrial park to promote the growth of vegetation.

Filling the annular void with MAPEQUICK CBS SYSTEM 1

The TBM used to dig the discharge tunnel was also equipped with a system to inject traditional one-component mortar to fill the annular void between the segments and the ground. As is well known from technical literature and practical experience,

this filler technology is highly sensitive to the availability and quality of the raw materials, as well as to the mix-design. To fulfil this need, Mapei proposed MAPEQUICK CBS SYSTEM 1, a liquid retarding agent with plasticizing effect which inhibits the setting times of cementitious mixes for long periods: its use allows to achieve workability up to 72 hours after the mix batching. Constant monitoring of the characteristics of its ingredients (cement, sand, fly-ash) and constant adjustment of the dosage rates of MAPEQUICK CBS SYSTEM 1 was just a part of daily on-site activities. Technicians from the contractor's quality department and the international Mapei UTT team worked together to fully meet project requirements and guarantee the right amount of mortar was injected into the TBM.

Producing concrete segments with Mapei admixtures

The same level of technical cooperation was implemented to develop the correct mix-design for the concrete used to manufacture the segments. The super-plasticising admixtures DYNAMON NRG 1014 and DYNAMON NRG 1022 were used, along with MAPEPLAST SF mineral addition based on densified silica-fume with pozzolanic action. These products were chosen due to their high technical performances and compatibility with local raw materials.



Find out more
POLYFOAMER ECO 100 PLUS



A view of the former industrial area (with regrown vegetation) just a few months after the disposal of the excavated material conditioned with POLYFOAMER ECO 100 PLUS.

TECHNICAL DATA

Matanza-Riachuelo Basin-Lot 3, Buenos Aires (Argentina)
Period of construction: 2017-2019
Period of the Mapei intervention: 2017-2019
Intervention by Mapei:

supplying concrete admixtures and materials for soil conditioning
Contractors: WeBuild, Chediack
Mapei coordinators: Mapei UTT Technical Services, Enrico Dal Negro, Alessandro Boscaro, Enrico

Barbero

MAPEI PRODUCTS

Concrete admixtures: Dynamon NRG 1014, Dynamon NRG 1022, Mapeplast SF
Backfill grout admixtures: Mapequick CBS System 1

Soil conditioning agent: Polyfoamer Eco 100 Plus

For further info on products: mapei.com, utt.mapei.com

Barberino di Mugello (Province of Florence, Italy)

Santa Lucia Tunnel

OPENED TO TRAFFIC IN MARCH 2022 ALONG THE A1 MOTORWAY IN CENTRAL ITALY, IT IS THE LONGEST 3-LANE TUNNEL IN EUROPE

The Apennine stretch of the A1 Milan-Naples motorway between Bologna and Florence in Central Italy is a winding road with numerous climbs and descents that can be hazardous for both cars and lorries. The 37 km-long A1 "Variante di Valico" link-road between La Quercia and Aglio, which opened in 2015, has led to drive times being reduced. The upgrade to the A1 along this stretch included the construction of a new lane on the south-bound carriageway towards Rome and a complete rebuild of the two existing lanes on the north-bound carriageway for traffic heading towards Milan. The Santa Lucia tunnel, along the stretch running between Barberino di Mugello and Firenze Nord, is one of the largest works carried out on the south-bound carriageway.

A complex feat of engineering

Inaugurated in March, 2022, the Santa Lucia road tunnel is 7,734 m long. A EPB (Earth Pressure Balance) TBM (Tunnel Boring Machine) with a diameter of 15.87 m was used to bore out the tunnel, the largest in Europe at the time of commencing work. The project was particularly complex due to local geological conditions and the potential presence of explosive underground gases. The area that had to be bored out, around 200 m², enabled three lanes with a width of 3.75 m each to be constructed, as well as an embankment, a pavement, ventilation and lighting systems and, under the road itself, an escape tunnel to evacuate drivers in the event of emergencies.



As tunnelling with the TBM advanced, segments made up of nine precast reinforced concrete elements were installed in sequence. The tunnelling technology adopted by the main contractor enabled the tunnel to be constructed at a rate of 9 m per day. Constant control of hydraulic loads during tunnelling was fundamental in preventing any impact on the water resources, both during tunnelling operations and from a more long-term perspective. In addition, the tunnel was constructed without interfering with the flow of traffic on the surface. Two aspects characterised this site: the actual dimensions of the tunnel and its impact on the environment. One of the largest in Italy and in the world, right from the start the Santa Lucia tunnel project was particularly focused on minimising the impact the products used to condition the soil during tunnelling would have on the environment. Mapei UTT provided continuous support during tunnelling operations, constantly checking that the optimal dosage rates of the products selected were applied in order to condition the soil correctly and to inject the backfill grout.

Admixtures and products for tunnelling and conditioning the soil

To make the precast reinforced concrete elements for the segments (each one 2.2 m long and 55 cm thick, weighing 16 tonnes), the mix designs used were formulated with DYNAMON NRG 1015 SC and DYNAMON NRG 1037 superplasticizers, developed specifically for this site. MAPEFORM W60 universal form-release agent was used for the formwork.

During tunnelling operations, the soil in the area around the shield was conditioned with POLYFOAMER ECO 100, a foaming agent made from surfactants combined with a natural lubricating polymer. This product differs from traditional foaming products, due to its very low environmental impact on water and on the ground conditioning. It was chosen for this project because it offered the best performance and environmental properties from amongst all those tested during the preliminary phase. Testing was carried out in the laboratories of Politecnico di Torino university, where conditioning tests were performed, and in the CNR (Italian National Research Coun-



ABOVE. With a diameter of 15.87 m, the TBM used for the Santa Lucia tunnel was the largest tunnel boring machine ever used in Europe at the beginning of the works.

cil) laboratory in Rome, which carried out environmental biodegradability and eco-toxicity tests. Muck excavated and conditioned with POLYFOAMER ECO 100 could be taken from site and transported to its destination very quickly. Using POLYFOAMER ECO 100 for the whole of the tunnel excavation enabled the contractor to carry out tunnelling quickly and safely, and also to reduce its environmental impact on the ground to a minimum. In total, around 1.7 million m³ of soil were excavated and conditioned with POLYFOAMER ECO 100. The backfill grout was injected through 10 individual lines at an average flow rate of 30-50 litres/minute, depending on the advance rate of the TBM. Keeping the injection pressure slightly higher than that of the EPB guaranteed that the mortar completely filled the annular voids and gaps between the concrete blocks and the ground.

The annular void between the segments and ground

were filled with a two-component cementitious mix containing two Mapei admixtures: MAPEQUICK CBS SYSTEM 1L retardant and MAPEQUICK CBS SYSTEM 3 accelerator.

Any defects found in the concrete were repaired with mortars from the MAPEFER, MAPEGROUT and PLANITOP ranges.

Injections of RESFOAM 1 KM FLEX one-component, flexible polyurethane resin were carried out behind the concrete segments where infiltrations of water were found.



Find out more
MAPEQUICK CBS SYSTEM 3



LEFT. The TBM breakthrough for the Santa Lucia tunnel took place on 8th June 2022.

RIGHT. The storage silos containing POLYFOAMER ECO 100 foaming agent.



TECHNICAL DATA

Santa Lucia tunnel, A1 Milan-Naples highway, Barberino di Mugello-Firenze Nord (Italy)

Period of construction: 2016-2022

Period of the intervention: 2016-2022

Intervention by Mapei: supplying admixtures for concrete, products for soil

conditioning and concrete repair

Owner: Autostrade per l'Italia SpA

Contractor: Pavimental SpA

Mapei coordination: Mapei UTT Technical Services, Enrico Dal Negro, Alessandro Boscaro, Enrico Barbero and Marco Manicastro

MAPEI PRODUCTS

Concrete admixtures: Dynamon NRG 1015 SC, Dynamon NRG 1037, Mapeform W60

Ground conditioning: Polyfoamer Eco 100, Defoamer XP/IO 1

Backfill grout admixtures: Mapequick CBS System 1L, Mapequick CBS System 3

Concrete repair: Mapefer,

Mapegrout Easy Flow GF, Planitop 200, Planitop Smooth & Repair R4, Resfoam 1 KM Flex

For further info mapei.com, utt.mapei.com

Organyà (Spain)

Tres Ponts Tunnel



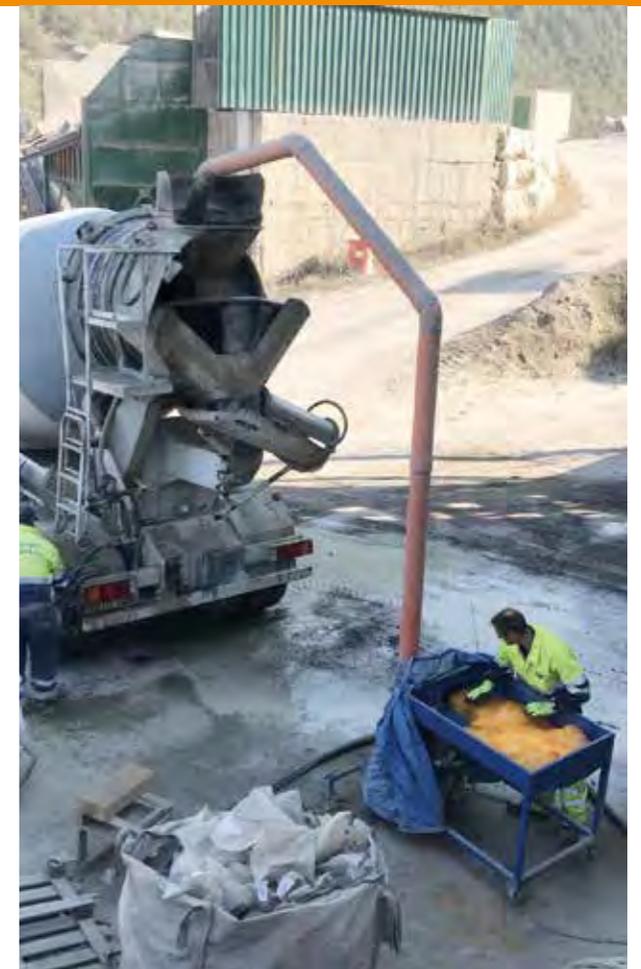
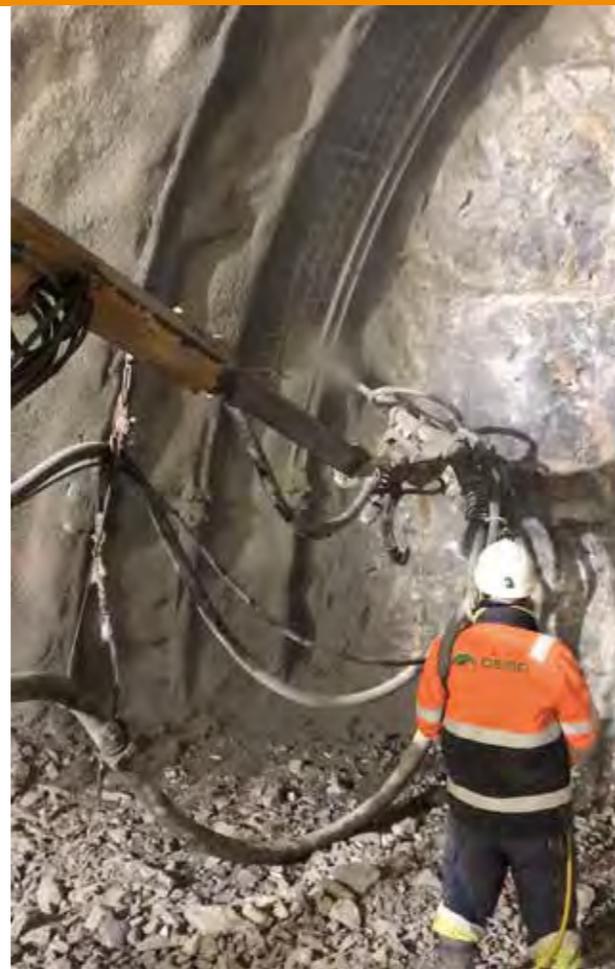
THE INFRASTRUCTURE GREATLY IMPROVED CIRCULATION FOR THE PYRENEES REGION'S INHABITANTS

Opened in November 2021 after 4 years of construction work, the new Tres Ponts tunnel, running parallel to the River Segre, is located along the C-14 road in the Alt Urgell region (Pyrenees) between the towns of Organyà and Montant de Tost. Thanks to the tunnel, residents of the region no longer have to negotiate narrow roads with tight, hazardous bends, often interrupted by landslides caused by bad weather. Construction of the tunnel (for a total cost of more than 35 million Euros) commenced in 2018 and was completed in 36 months, as stipulated in the initial project, which included not only the excavation of the tunnel, but also widening of the roads adjacent to the tunnel. With its inauguration, the infrastructure greatly improved circulation for the region's inhabitants, as well as for the entire north-south communications axis between the cities of Lleida and Andorra.

Underground construction work

The Tres Ponts tunnel is 12.6 m wide, 7.9 m high and 1.3 km long and has two 3.5 m wide lanes, one for each direction. Two sidewalks alongside the road (1.5 m wide) were also constructed, as well as two emergency tunnels (4.10 m wide) that exit onto a road closed to traffic, in order to allow the drivers to evacuate the tunnel in the event of dangerous situations. The rock excavated and extracted during tunnelling was transformed into aggregates used directly in the production of the concrete used for the gallery. This led to considerable savings from a sustainability perspective by reducing both transport and storage areas and consumption of natural resources. Mapei Spain's UTT team also worked on the site, recommending the most suitable admixtures for the concrete used in the construction work and providing an ongoing consultancy and technical service as work progressed to

ABOVE. Opened in November 2021 after 4 years of construction work, the new Tres Ponts tunnel is located in the Alt Urgell region (Pyrenees).



ABOVE, LEFT. The use of Mapei admixtures enabled the formulation of a concrete mix design with high quality spray pattern, even at low temperatures.

RIGHT. Applying shotcrete admixed with MAPEQUICK AF T100.

IN THE FACING PAGE

Top, left: lining the tunnel surfaces with concrete admixed with DYNAMON SX T. In the middle, left: MAPEFIBRE IT39NV fibers were added to the concrete mix.

On the right: constructing the base layer of the tunnel floor with concrete admixed with DYNAMON SX T and MAPEPLAST N16.

optimise the various phases and application of the recommended products.

Excavation and pre-lining of the tunnel were carried out according to criteria adopted with the construction method for shotcrete tunnels. This method consists in spraying concrete mixed with set-accelerators so that the concrete immediately bonds to the surface without having to use formworks. The concrete mix design supplied had to guarantee a quality spray pattern, even at low temperatures (which are common in winter in the area), and included high-performance admixtures to guarantee optimum application.

Supplying the right admixtures

The Mapei UTT team worked on site to help formulate the mix design and during tunnelling operations, recommending DYNAMON SX T, a superplasticizer which is distributed in Spain by Mapei Spain (its counterpart on the international market is DYNAMON SX). This product, based on modified acrylic polymer, was used to formulate concrete with low water/cement ratio, high mechanical strength, long slump retention, and extended workability.

These characteristics made it ideal for the shotcrete, where a lower water/cement ratio (0.38-0.41) is needed, along with good plasticity, an essential requirement to optimise the mix. This admixture is also very versatile and adapts to various types of aggregate, such as in this case in which a high percentage of the materials obtained during tunnelling was used.

Apart from DYNAMON SX T1, MAPEQUICK AF T100 alkali-free, inorganic salt-based liquid accelerant (which is also manufactured and distributed in Spain by Mapei Spain) was also added to the mix prior to spraying. These two products work together to form an admixture system ideal for fast-setting shotcrete.

MAPEFIBRE IT 39 NV structural polypropylene fibers were also added to make the concrete more ductile in the post-failure phase, enabling loads to be distributed more evenly and eliminating the need to install metal mesh on the substrate.

Once tunnelling had been completed, DYNAMON SX T1 was again used in the lining for the internal surfaces where the concrete needed to have high workability, be easy to apply at the fresh state and have excellent me-

chanical properties at the hardened state.

For other concrete mixes used on site, DYNAMON SX T1 was mixed with the liquid admixture MAPEPLAST N16, a plasticizer used to formulate concrete with medium mechanical strength. This concrete mix was used to construct the base layer of the floor in the tunnel.

This article was taken from Realidad Mapei 31/2022, a magazine published by Mapei Spain, whom we would like to thank.



**Find out more
DYNAMON SX**

TECHNICAL DATA

Tres Portos tunnel, Organyà (Province of Lleida), Spain
Period of construction: 2018-2021
Period of Mapei intervention: 2018-2021
Intervention by Mapei:

supplying admixtures and fibers for the mix design for concrete and shotcrete
Owner: Infraestructures Cat
Design: Ayesa - Kreum
Main contractor: Acciona - Copcisa
Subcontractor: Obras

Subterràneas
Mapei coordinator: Marc Benito, Mapei Spain

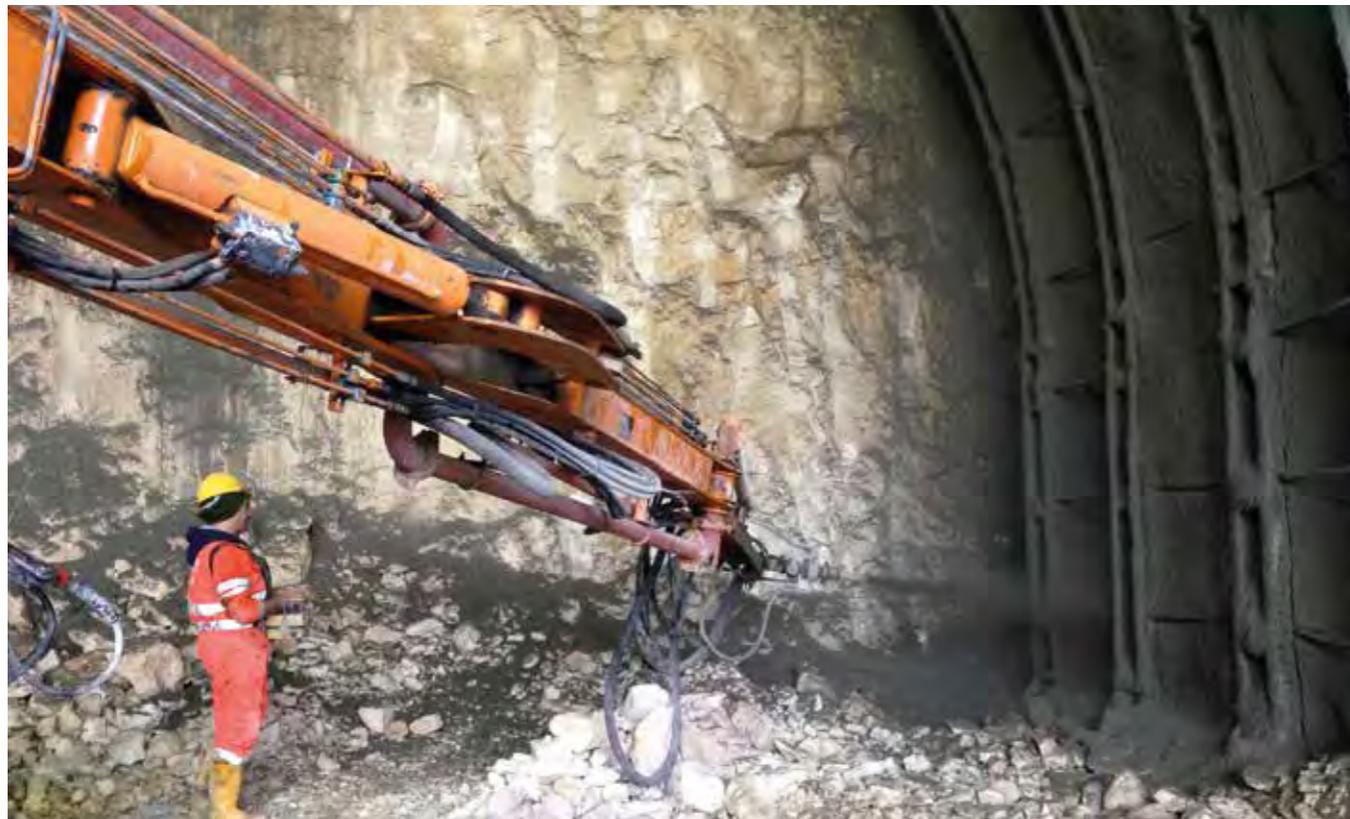
MAPEI PRODUCTS
Concrete admixtures: Dynamon SX T*, Mapeplast N16*, Mapequick AF T100*
Fibers: Mapefibre IT 39 NV

*These products are manufactured and distributed on the Spanish market by Mapei Spain

For further info: mapei.com, mapei.es

Vicenza-Treviso (Italy) Veneto Foothills Motorway

AN EXTENSIVE RANGE OF PRODUCTS FOR UNDERGROUND WORK
ALONG AN IMPORTANT MOTORWAY IN NORTHERN ITALY



TOP OF THE PAGE. Applying shotcrete in the tunnels. **BELOW, LEFT.** Waterproofing the tunnels with MAPEPLAN TU S. **RIGHT.** The tunnel surfaces were painted with MAPECOAT W HRI epoxy coating.

The Pedemontana Veneta toll-road, or Veneto Foothills motorway, is a by-pass in Northern Italy that, once completed, will connect Montecchio Maggiore, in the southern part of the Province of Vicenza, to Spresiano, in the northern part of the Province of Treviso, passing through the Thiene-Schio industrial park, Bassano del Grappa and to the north of Treviso, before linking with three motorways (A4, A31 and A27). At the moment it is possible to drive from Malo to Spresiano, a distance of 80 km of its total length of 97.7 km once completed.

The by-pass serves an extensive area of a territory with 114 towns and cities, 37 of which are directly connected to the by-pass, with 22 in the Province of Vicenza and 14 in the Province of Treviso. The by-pass will meet the demand for greater mobility generated in the area around the foothills, the most urbanised and industrialised in the Veneto region. It will also allow to complete a road network of the highest level that will be integrated into the transport network of European corridors.

Admixtures, waterproofers and coatings

Mapei UTT (Underground Technology Team) supplied products and technical support to the contractors working on the underground sections of the Pedemontana Veneta by-pass along the stretch connecting the A4 motorway and Malo, which includes a total of 16 km of tunnels.

The double-barrel tunnels at Castelgomberto and Sant'Urbano are 6.5 and 1.5 km long, respectively, with an additional 800 m of emergency tunnels.

The collaboration between Mapei UTT and the main con-

tractors started when work commenced back in 2014 and in continued until their completion in December, 2022.

Both shotcrete and poured concrete using formwork were used in the construction of the tunnels.

For these works, Mapei supplied MAPEFIBRE CN54 structural polypropylene fibers to make the fibre-reinforced, high ductility concrete; DYNAMON SX MC and DYNAMON SX 34 super-plasticising admixtures, MAPEQUICK AF 1000 and MAPEQUICK AF 350 set-accelerators for the shotcrete and MAPEGROUT GUNITE fiber-reinforced cementitious mortar for lining tunnels.

CABLEJET plasticizing and expanding agent was used for preparing shrinkage-free, highly-fluid pumpable slurries for anchoring tie rods, while STABILCEM T, one-component pre-blended shrinkage-compensated thixotropic mortar, was used for fixing bolts for steel reinforcement meshes.

The internal surfaces of the tunnel were waterproofed with MAPEPLAN TU S PVC-P synthetic membrane, chosen in its white-off version.

MAPECOAT W HRI two-component epoxy protective coating (chosen in its RAL 9010 and RAL 2002 colour shades) was used to finish off the surfaces of concrete walls in the tunnels.



Find out more
MAPECOAT W HRI

TECHNICAL DATA

Castelgomberto and Sant'Urbano tunnels, Veneto Foothills

Motorway, Castelgomberto and Sant'Urbano, Provinces of Vicenza and Treviso (Italy)

Owner: Veneto Region

Period of construction: 2014-2022

Period of the Mapei

intervention: 2014-2022

Intervention by Mapei: supplying admixtures for concrete and shotcrete, products for waterproofing and lining tunnels

Mapei coordination: Mapei UTT, Enrico Dal Negro, Giorgio Tansini, Davide Michelis, Manuel Giamporcaro

MAPEI PRODUCTS

Structural fibers: Mapefibre CN54

Concrete admixtures:

Dynamon SX MC,

Dynamon SX 34,

Mapequick AF 1000,

Mapequick AF 350

Waterproofing:

Mapeplan TU S

Anchoring: Stabilcem T,

Cablejet

Tunnel lining: MapegROUT

Gunite

Protective coating: Mapecoat

W HRI

For further info on products

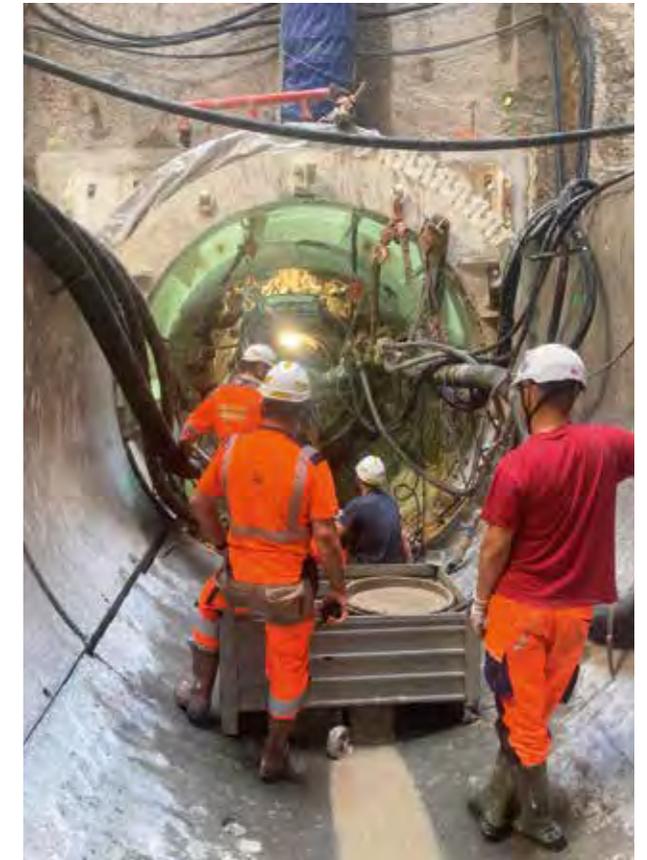
see mapei.com and

utt.mapei.com

Saint-Denis (France)

Underground powerlines

THE PROJECT - THE FIRST OF ITS KIND IN FRANCE – INVOLVES BORING OUT TUNNELS IN A HIGHLY BUILT-UP AREA WITH ROAD, RAIL AND RIVER INFRASTRUCTURES



In preparation for the 2024 Paris Olympic Games, and construction of the Olympic and Paralympic Village in particular, work is ongoing in Paris and its outskirts to run powerlines underground and free-up more than 80 hectares of land. In fact, by 2024, the local provider RTE (Réseau Transport Electricité) is planning to run four 225 kilovolt powerlines underground, which are going to substitute 15 km of cables running on 27 pylons and pass through the towns of Saint-Denis, Villeneuve-la-Garenne and l'Île-Saint-Denis, close to the French capital. This intervention is part of the Mesil (Mise en Souterrain d'Initiative Locale) project. The sheer size of the project is awe-inspiring – and the first of its kind in France – and will involve boring out deep tunnels in a highly built-up area where numerous road, rail and river infrastructures are located. Work is carried out on extremely important pow-

erlines that feed the Gare du Nord railway station, Line 13 of the Paris Metro and the entire area to the north-west of the city (with a population of more than 800,000). There are other sites currently ongoing in the same area which means work needs to be very carefully coordinated, also taking into account the future reorganisation of the urban layout with 2 km of tunnels at a depth of 50 m.

To overcome the challenges of this part of the project, RTE opted for the construction of an underground tunnel through which the new powerlines will pass: an appropriate solution for a particularly congested and densely populated area. The tunnel, around 2.5 km long, is 3 m in diameter and runs at a depth of 50 m. For the tunnelling work, carried out by a 120 m long TBM with a diameter of 3.9 m called Ambra, 120,000 liner segments had to be installed.

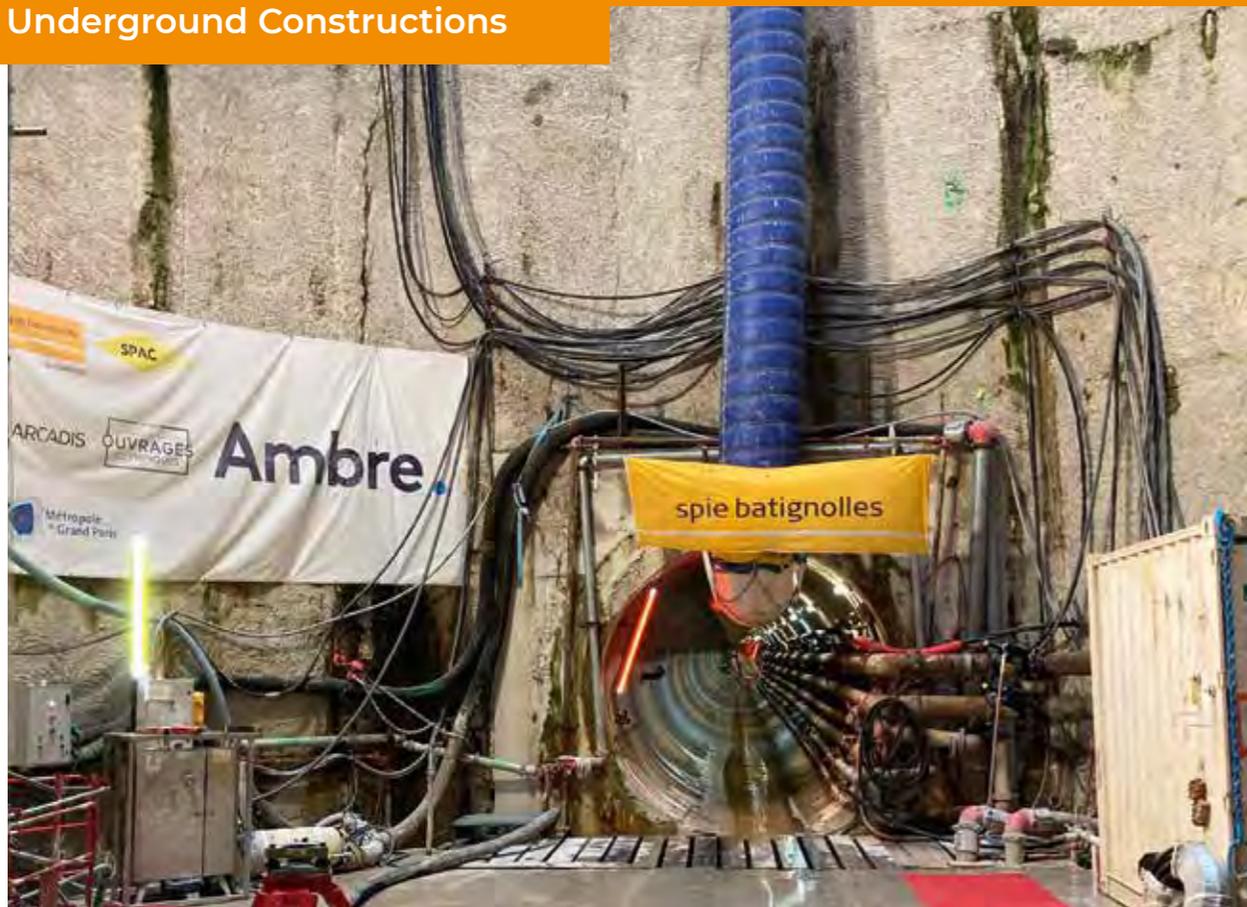
Backfill grouts with Mapei two-component systems

While tunnelling, a TBM leaves an annular void between the ground and the extrados of the segments when they are placed in position and this void has to be filled as the TBM advances. Depending on particular site constraints and decisions taken by the main contractor, the voids may be filled with grouts or two-component grout, in which component A is made from water, bentonite, cement and a set retardant and component B is a set accelerator.

The two-component system proposed by Mapei, thought to be the most suitable for this site by the main contractor Spie batignolles, had already been used on other sites such as Lots T2A and T2B of the 15 Line South of the Grand Paris Express project (see *Realtà Mapei International* no. 92), the extension of the safety tunnel for the RER C in

IN THESE PAGES

Excavating the tunnel with a TBM called Ambra. Mapei products for tunnelling made works easier.



TOP. The entrance to the tunnel constructed to run powerlines underground.

Meudon and site SMP4 for the Tunnel Euroalpin Lyon Turin (TELT). Because of the constraints imposed by the mechanical properties required, along with the high pressures due to the sheer depth of the tunnel, a preliminary study had to be carried out in the Mapei laboratories. The products proposed are the following:

- MAPEQUICK CBS SYSTEM 3: a liquid product used as accelerator of cement-based mixes for injection, particularly suitable for extremely fluid mixes with a very high content of water.
- MAPEQUICK CBS SYSTEM 1: a liquid retarding agent with plasticizing effect which inhibits the setting times of cementitious mixes for long periods. It is specifically designed for cementitious mixes that need long workability times, for example, because of long transportation times or long pumping distance.
- MAPEBENT API 2: a natural sodium bentonite suitable

for every type of civil engineering application fields. It conforms the international API specifications about materials to be used for drilling fluids and bentonite based slurries and can be used in every civil engineering application fields, especially where a quick activation of bentonite in water is required and where the mix should have an easy pumpability and high volumetric stability.

This article was taken from issue N° 52 of Mapei et Vous, the magazine published by Mapei Group's subsidiary Mapei France, whom we kindly thank.



Find out more
MAPEBENT API 2

TECHNICAL DATA

Mesil RTE, Seine Saint-Denis (France)
Period of construction: 2021-2024
Period of the intervention: 2021-2022
Intervention by Mapei: supplying products for injections and TBM works

Owner: RTE (Réseau Transport Electricité)
Project manager's assistant: Arcadis
Contractors: Spie batignolles génie civil, Spie batignolles fondations, Spac and Setec TPI
Works direction: Setec
Mapei coordinators:

Mapei UTT Technical Services, Edgar Doledec, Jérôme Darras
Photos: Edgar Doledec, Vincent Collin, Pascal Tournaire

MAPEI PRODUCTS

Bentonite: Mapebent API 2, Mapedisp FLS

Backfill grout admixtures: Mapequick CBS System 3, Mapequick CBS System 1

For further info on products see mapei.fr, mapei.com and utt.mapei.com

Bergen (Norway)

Løvstakken Tunnel

PRODUCTS FOR INJECTIONS TO OVERCOME THE PRESENCE OF AN AQUIFER

The Løvstakken tunnel has been constructed to provide a new link between the Fyllingsdalen district with Kristianborg and the Årstad district. To create this link, two parallel tunnels, each around 3 km long, were excavated directly into the mountain: a main tunnel for the twin-track Bybanen tramline and a safety tunnel that can also be used by pedestrians and cyclists, the longest of its kind in Europe.

Two chambers, each measuring 200 m in length, were also excavated on the western side, in Fyllingsdalen, and will be used as an underground storage area and a maintenance centre for the Bybanen trams. The two chambers will be directly connected to the tramline tunnel. The tunnels and chambers were constructed using traditional tunnelling methods and a total of around 500,000 m³ of excavated material was removed.

Mid-way through 2019, the team unexpectedly hit a fault zone with groundwater. In some points, up to 1,000 litres per minute were pouring out of the bored holes. As a result, the additional pre-injections requested made operations much more difficult. The conditions of the rock represented a particularly difficult challenge for the team. Systematic pre-injections were carried out to move the water before continuing with the main operations, and

then post-injections were applied where further sealing was required.

Admixtures and grouts for concrete and products for injections

For this intervention Mapei AS, the Group's Norwegian subsidiary, supplied numerous admixtures for the mix-design of the concrete (DYNAMON SX-23*, MAPE-TARD SD-2000, MAPEAIR 25* and MAPECURE CCI-2000) and for the shotcrete (MAPEQUICK AF 118 N, MAPEQUICK AF D03 and MAPEQUICK AF-2000), mortars for the shotcrete (GROUT TECH 5000*, GROUT TECH SYSTEM W* and MAPEI MICRO*) and products for the injections (MAURING*, RESFOAM 1KM, RESFOAM 1KM AKS and ZINK-BOLT*).

*These products are distributed on the Norwegian market by Mapei AS.



Find out more
RESFOAM 1K-M



TECHNICAL DATA

Løvstakken Tunnel, Bergen, Norway
Period of construction: 2018-2022
Main contractor: Marti Norge
Owner: Bybanen Utbygging
Mapei coordinators: Kenneth Gundersen, Roy Hansen, Rune Espeseth and Hans Olav Hognestad, UTT, Mapei AS (Norway)

Waterproofing systems for tunnels

SPRAY-APPLIED POLYMERIC MEMBRANES AND SYNTHETIC MEMBRANES FOR A PERFECT RESULT IN ALL TYPES OF JOBSITES

The construction of infrastructures through the investment of public money is, from a historical perspective, one of the cornerstones of many countries' economy.

When we talk about sustainability, we immediately think about reducing CO₂ emissions, adopting innovative technologies, using more efficient and longer-lasting materials, extending life cycles and then recycling materials. In the context of underground constructions, maintenance work on existing infrastructures plays a fundamental role, since it is far more cost-effective and sustainable to extend their service life than to construct new ones. Tunnels are obviously no exception.

The environments in which tunnels are constructed are very peculiar and can vary considerably. As a result, projects can be very different: they may be covered with shotcrete or with concrete cast-on-site, or even lined with precast concrete. In all cases, there are certain common fundamental criteria in order to ensure optimal service conditions for tunnels:

- the integrity of the coating or lining which must preserve its structural support capacity;
- the waterproofing of the infrastructure so that any infiltrations of water from the ground do not damage service equipment, resulting in disruptions for users.

Waterproofing tunnels lined with shotcrete

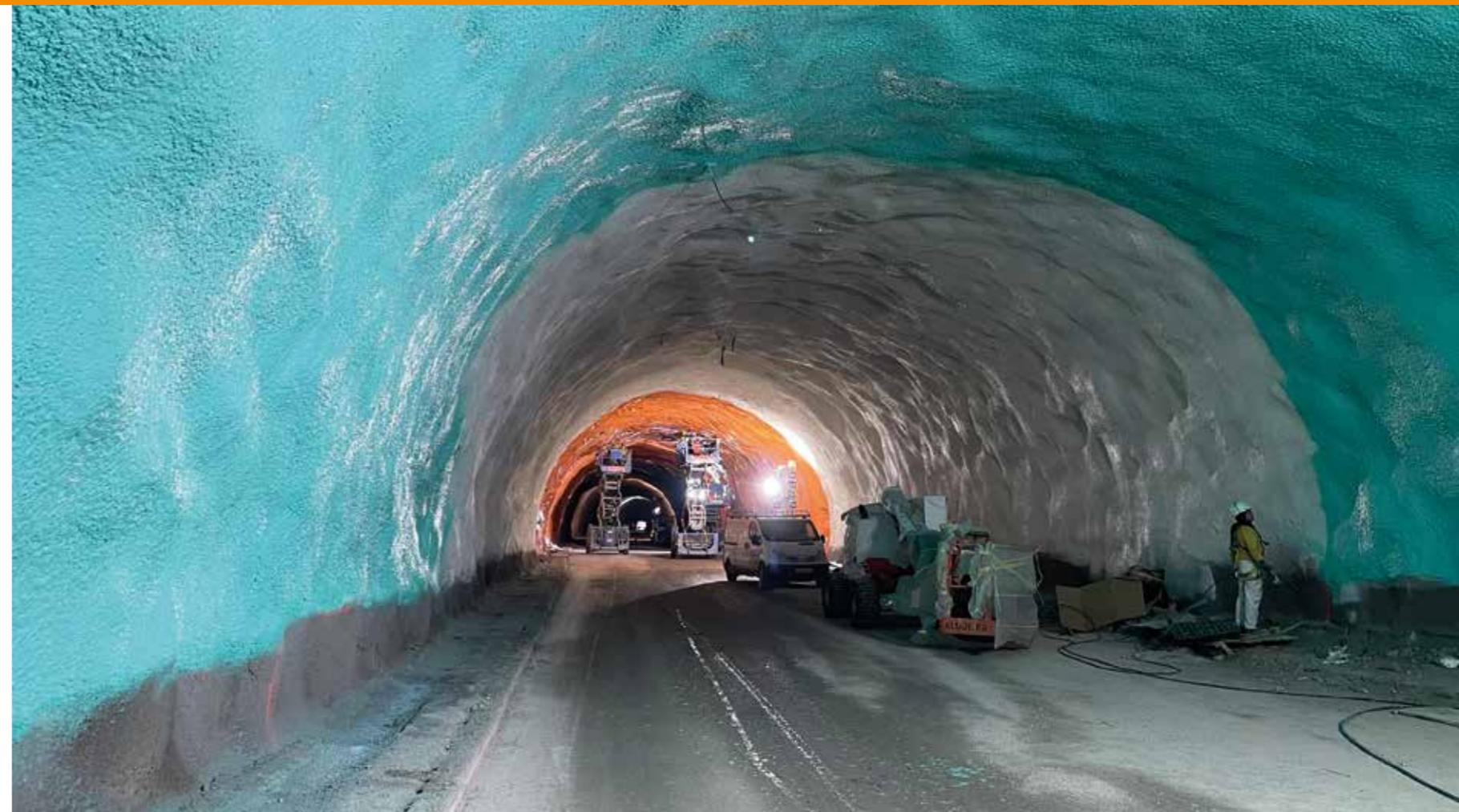
Mapei's UTT (Underground Technology Team) has an extensive array of technologies, products and systems available to meet all the needs and requirements of designers and construction companies when they face problems encountered on site during underground construction projects.

In this article we will present two waterproofing systems recommended for repairing and strengthening tunnels lined with shotcrete, which are widely used in road and railway tunnels. Shotcrete is a very versatile material and, historically, is used to support and strengthen tunnels bored out using traditional methods because, due to the way it is applied, it enables work to progress quickly without having to use formwork.

Technologies currently available on the market, such as admixtures, superplasticisers and alkali-free setting accelerators, as well as synthetic structural fibres and modern shotcrete spray equipment, enable high quality concrete and more durable structures to be easily obtained.

On the ground side, shotcrete comes into contact with potentially aggressive substances, such as sulphates or aggressive water that could easily penetrate into the matrix of the material, which is more porous and less dense than cast-in-situ concrete. Also, shotcrete is not free from the risk of carbonation,

The integrity of the lining and the waterproofness of the infrastructure are key elements to ensure high performances for the tunnels



Mapei proposes two systems for repairing and waterproofing in tunnels: the spray-applied polymeric membrane MAPELASTIC TU SYSTEM and MAPEPLAN TU synthetic PVC-P membranes. They can be used in the same jobsite, as in the case of the Belabieta tunnel (in the photo above), along the A-15 mortarway in Spain.

and to this we must also add the effect of other aggressive elements present in exhaust fumes from vehicles (cars and lorries in road tunnels and diesel trains in older rail tunnels). Lastly, shotcrete is often applied in combination with metal strengthening elements such as nets and bolts, metal mesh and "Bernold" sheets: it is, therefore, a type of lining that is highly vulnerable when exposed to various types of aggressive agents: attack from chemical substances (sulphates and acid-basic reactions), infiltrations of water, delamination and cracking provoked by oxidation of metal elements when carbonation penetrates through the lining. These factors all play a part in the deterioration of the lining and, as a result, compromise its structural capacity.

MAPELASTIC TU SYSTEM

Any repair and/or strengthening project on an existing tunnel must include a waterproofing system that protects the new lining from aggressive agents and the presence of utility systems.

MAPELASTIC TU SYSTEM is a spray-applied polymeric membrane for waterproofing underground tunnels and structures. It is highly flexible, has high tensile strength and adheres very firmly to cementitious substrates such as, of course, shotcrete.

Once applied to the substrate, MAPELASTIC TU SYSTEM forms a waterproof barrier with excellent adhesion properties, which makes it ideal for creating "sandwich" type waterproofing systems applied between layers of shotcrete or cast-in-situ concrete (with the substrates properly prepared) and shotcrete. This product is ready to use and needs to be applied with a high-pressure, airless pump, which makes application more practical, faster and cleaner without giving off dust into the environment, and makes it possible to carry out other activities in the tunnel at the same time.

Using MAPELASTIC TU SYSTEM allows creating a waterproof barrier with excellent adhesion properties

The consumption rate is around 4 kg/m² every 3 mm of thickness, which creates a certified waterproofing capacity of more than 15 bar water column. It may be applied in a single layer or in two steps (two layers at a rate of 2.0 kg/m²), applying a first layer of white MAPELASTIC TU SYSTEM followed by a second layer of green MAPELASTIC TU SYSTEM a few hours later. Applying the product in two layers gives better final results and has several advantages:

- better control of how it covers the substrate thanks to the contrasting colours: a first white layer over grey concrete and a second green layer over the white one;
- consistent final thickness over the entire surface where it is applied;
- better control of consumption.

The excellent adhesion properties of the membrane means that the substrate and the new lining work as one from a structural perspective, while strengthening of the concrete can be achieved by using synthetic fibres or structural metal fibres.

The peculiar characteristics of MAPELASTIC TU SYSTEM also make it ideal for creating a preventive waterproofing system, or for use in areas where the amount of water infiltrations is not particularly high. Existing water infiltrations must be treated beforehand by injecting resin. MAPELASTIC TU SYSTEM may be combined with other waterproofing systems, such as PVC-P synthetic membranes. In fact, in tunnels where there are a lot of infiltrations, carrying out preliminary work to seal or drain off water can be laborious or too costly. There are other systems – such as PVC-P membranes – which, in such cases, are far more effective.

In these pages, applying MAPEPLAN TU membranes during tunnel repair operations.



ABOVE, RIGHT. MAPEPLAN ANCHORING is an anchoring element with M16 bar embedded in heavy-duty plastic case.

THE MAPEPLAN TU LINE

Synthetic membranes from the MAPEPLAN TU line, with their distinctive orange signal layer, are specifically designed for waterproofing tunnels, usually in which the final lining is created using formwork, although they may also be used in those with a shotcrete lining. In this case, it is fundamental to apply a reinforcement mesh before applying the spray-applied coating because there is practically no adherence between concrete and PVC.

When using this system, it is recommended to install a membrane from the MAPEPLAN PROTECTION line over the MAPEPLAN TU membrane to prevent damaging the waterproofing membrane when installing reinforcement meshes or during application of the shotcrete lining.

Thanks to a watertight anchoring element, MAPEPLAN ANCHORING, it is possible to anchor the reinforced shotcrete to the substrate mechanically, thereby guaranteeing the maximum level of waterproofing for the system. MAPEPLAN ANCHORING is a precast element consisting of a steel bar embedded in a rigid, PVC case, which is installed into the concrete with the use of MAPEFIX VE SF resin, to form an anchor point with a load capacity of more than 120 tonnes. Once installed, the in-built flange is heat-welded to the main membrane to seal the hole.

The two waterproofing systems described in this article may be interconnected, or a transition zone may be created between the two systems by applying MAPEPLAN TAPE PVC, flexible PVC sealing tape to create a continuous waterproofing system, both widthways and lengthways, according to specific project requirements.

MAPEPLAN TU PVC-P synthetic membranes can be used together with anchoring and protective products

Marc Benito. Country Manager, UTT (Underground Technology Team), Mapei Spain



by Marta Bovassi

Repair work on sewer pipes

FROM THE MAPEI LABORATORIES: SPECIFIC PRODUCTS FOR ANY TYPE OF DEGRADATION

Sewer systems are essential infrastructures in order for urban areas to function correctly by ensuring that wastewater is transported and treated. They are made up of a network of masonry and concrete channels and pipes, running mainly underground. They often have no protective coatings or covering and are at risk, therefore, of degradation due to the aggressive nature of the water flowing through them. Apart from chemical-type degradation caused by organic and inorganic substances dissolved in the water, they are also at risk of physical degradation from mechanical loads and stresses, such as variations in traffic conditions on the road network above the sewers or the connection of new channels or pipes, increased flow rates and wear due to the abrasive action of debris. Damage deriving from the degradation of these infrastructures can have significant consequences for the environment, such as indirect contamination of the ground and pollution to water flowing both above ground and below ground level.

Periodic repairs are required, therefore, to guarantee they function correctly and ensure they have an adequate "service life". The Mapei Research laboratories also dedicate their efforts to the development of bespoke products for repairs work on sewer systems. In order to formulate a repair product that is effective, first and foremost the aggressiveness of the environment needs to be defined, based on the type of water discharged into the pipes.

In compliance with Italian Decree 152/06, wastewater can be divided into three categories according to its origin: domestic waste water, industrial waste water, and urban waste water. These different types of water may be channelled into the same pipes or kept separate, depending on the layout of the sewer system installed in each area. So, for every repair intervention, it is fundamental to define the level of aggressiveness of the water on the basis of analyses. Waste water can be considered slightly aggressive, such as rainwater for example, rather than highly aggressive, such as from human metabolism and domestic activities. According to the level of aggressive-

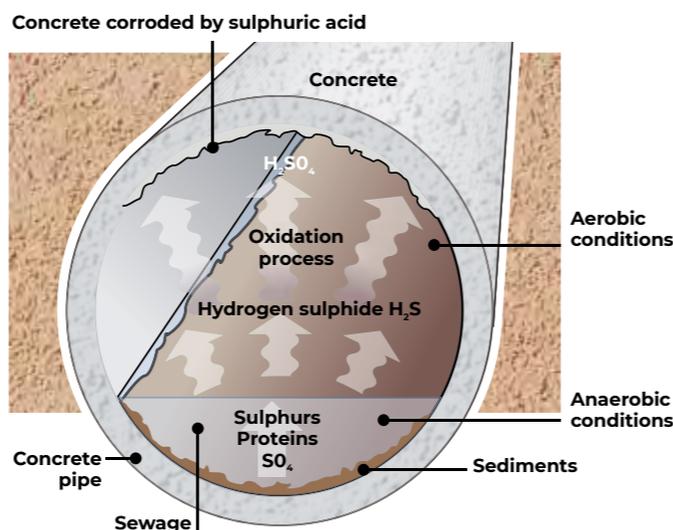


FIGURE 1. The formation of sulphuric acid in a sewer pipe.

ness, the minimum requirements a product used for repair work needs to meet must be defined. Slightly aggressive water will always contain low concentrations of organic and inorganic micro-pollutants, such as detergents, hydrocarbons, oil, chlorides, sulphates and nitrates, as well as other substances that attack the cementitious paste of traditional products. However, products containing special hydraulic binders can be developed that have a good level of durability thanks to their chemical composition and physical-mechanical characteristics.

Products for highly aggressive water

In the case of channels and pipes carrying highly aggressive water, such as water containing a high concentration of organic material from lavatories, the main cause of degradation is the presence of sulphuric acid (Fig. 1) originating from bacteria in raw sewage by means of aerobic and anaerobic processes that quickly dissolve the cementitious paste and deteriorate the matrix of mortar and concrete. In these kinds of environment,



FIGURE 2. Change in the visual appearance of mortars after immersion in sulphuric acid.

products that have passed specific acid-resistance tests need to be used. Mortars designed for coating these types of channels and pipes are covered by DIN 19573 standard, which classifies them according to their level of chemical resistance with an alpha-numeric code such as XWW4, which corresponds to a product with the highest level of resistance to corrosion caused by exposure to biogenic sulphuric acid. Mapei recently completed a research project to develop a new product called PLANITOP SEWAMENT XWW4, an addition to other products already available for this type of application. Specifications to achieve XWW4 classification are extremely severe: the degree of degradation is evaluated after immersion in sulphuric acid in environments at different pH levels (pH 0 and pH 1). Determining its residual compressive strength (that is, its performance properties after immersion in an aggressive environment compared with the same product without conditioning) indicates up to what point the structure of the material has deteriorated and enables the amount of corrosion due to the effect of the acid to be defined. In Figure 2, we can see the drastic change in the visual aspect and the

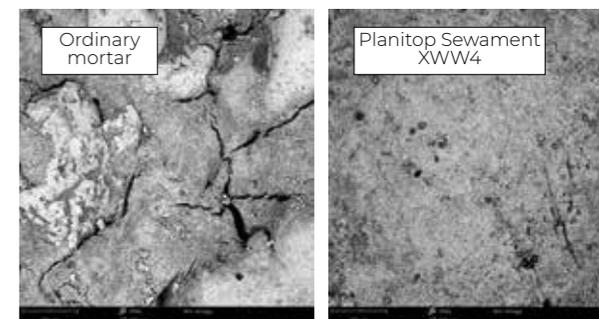


FIGURE 4. Image through an electron microscope of the surface of mortars after immersion in sulphuric acid.

significant reduction in the dimensions of ordinary mortar, after being immersed in acid, compared with XWW4 class mortar, which remains almost unchanged. The graph in Figure 3 compares the compressive strength of the two mortars after immersion in water and their compressive strength after immersion in acid: the significant reduction in compressive strength of the ordinary mortar confirms the high amount of corrosion observed during the visual inspection and its unsuitability for use in repair work on sewer systems. The XWW4 class mortar, on the other hand, confirms a high level of residual compressive strength (> 55% as specified by DIN standards) and a low amount of corrosion.

Analysis through an SEM scanning electron microscope (Figure 4) confirms the high resistance to sulphuric acid of the XWW4 mortar compared with ordinary mortar, in which cracks are clearly visible. Defining a high performance product for repairing sewer systems, even in the most severe exposure conditions, is the result of thorough research work through careful, precise experimentation, besides selecting and optimising the most appropriate type of binder and aggregate in order to balance material quality and cost-effectiveness.

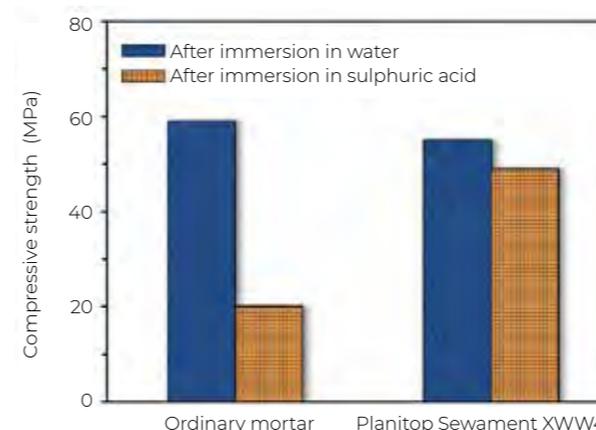


FIGURE 3. Compressive strength of the mortars after immersion in water (blue column) and in sulphuric acid (orange column).

Building Line, Research & Development Laboratories, Mapei SpA (Italy)

Zurich (Switzerland)

Maintenance work on the sewer systems

WHEN CARRYING OUT REPAIR WORK, CEMENTITIOUS MORTARS, EPOXY RESINS AND PRODUCTS FOR CERAMIC COVERINGS ALL PLAY A FUNDAMENTAL ROLE



Mapei products are currently being used on the Zurich sewer system, as part of a series of works financed by Zurich City Council with an investment of almost 14 million Euros.

The city of Zurich boasts a long tradition in the construction of cutting-edge sewer systems, ever since the first modern type of sewer was constructed in the Selnau district in 1860. By 1960 a modern sewerage system covered the entire city, while today, Zurich's almost 1,000 km-long system of sewer channels caters for the needs of more than 45,000 buildings, directing 200,000 m³ of waste water along various pipe networks and channels up to the water-treatment plant in Werdhölzli.

Control and maintenance of the sewer systems

To guarantee the complete functionality of the sewer system, checks are carried out on a regular basis in order to identify and repair any signs of degradation as early as possible.

In fact, the channels in the sewer system have a service life of around 80 years, after which they are no longer suitable for use and have to be repaired or replaced. For a system extending for 1,000 km, like the one in Zurich, this means that around 12 km of channels need to be repaired every year. For these interventions, methods and technologies have to be adopted that reduce the impact work has on normal activities at street level.

Renovation of the channels accessible on foot

The channels of the Zurich sewer system accessible on foot are mainly made from reinforced concrete and are circular, rectangular or oval in shape. They are constantly subject to degradation due to various phenomena: attack from carbon dioxide, due to the formation of condensation on the concrete surfaces, or corrosion to the concrete and steel reinforcement, due to the penetration of chlorides and other pollutants. Apart from attack of a chemical nature, there are also mechanical and static loads and stresses that can provoke subsidence, leaching, corrosion and cracking. Damaged sections of channels are repaired immediately to prevent the risk of them contaminating drinking water.

Concrete repair with cementitious mortars

Cementitious construction materials and epoxy resins play an important role in these types of application because of the benefits offered by their binding power. Amongst the repair materials specifically developed by Mapei for use in sewer systems, the ones that stand out in particular are the cementitious mortars applied using the wet-spray method, which are resistant to attack from sulphates and chemical agents, and cementitious coatings specifically formulated to resist wear caused by gases and other aggressive agents. Amongst these cementitious mortars there are MAPEGROUT THIXOTROPIC, MAPEGROUT T60 and MAPEGROUT EASY FLOW, all compliant (and classified as R4) with the requirements of EN 1504-3 European standard regarding products for protecting and repairing concrete structures. What is more, they also meet the requirements of Zurich City Council specifications for this type of use. Their workability, high pumpability and reduced rebound make repair work on sewer systems much easier, starting from handling and



1-2. Cementitious mortars are being used to repair concrete in the Zurich sewer network, such as MAPEGROUT T60, MAPEGROUT THIXOTROPIC and MAPEGROUT EASY FLOW. Thereafter, MAPEFINISH HD and MONOFINISH HD are used to create a protective coating on the concrete surfaces of the sewer channels.

transport practices and use in confined spaces. And this is why they are currently being used on sections of the Zurich sewer system, for a total length of 2,000 m, as part of a series of works financed by Zurich City Council with an investment of almost 14 million Euros.

Protection with MAPEFINISH HD and MONOFINISH HD

After applying the repair mortar, and if required by the designers, the concrete surfaces are normally protected by coating them with a manual application of a 3-6 mm layer of MAPEFINISH HD two-component cementitious mortar or MONOFINISH HD one-component cementitious mortar, both with high resistance to sulphates. These two mortars meet the requirements of European standard EN 1504-2, which evaluates the performance properties of products and systems for repairing concrete surfaces and their impact on the durability of reinforced concrete structures. MONOFINISH HD and MAPEFINISH HD both offer high resistance to attack from chemical agents and sulphates. Also, their high resistance to biogenic sulphuric acid and abrasion (class A5 according to Böhme standards) guarantee long-lasting protection against pollutants, leaching and abrasion.

Installing and grouting ceramic coverings with KERAPOXY

In certain stretches of the Zurich sewer system, it was decided to create ceramic coverings and bond them to the concrete elements. These types of coverings are particularly suitable for this kind of environment because of their resistance to mechanical stresses and chemicals, as well as for the lower amount of cleaning required and for their hydraulic performance properties.

In this particular case, ceramic materials such as klinker and porcelain tiles were chosen to cover the channels of the Zurich sewers.

And to ensure strong and durable bonding with the concrete elements, Mapei proposed epoxy adhesives in water dispersion such as KERAPOXY two-component, anti-acid epoxy mortar, which is highly resistant to acids and abrasion and may be used both as adhesive and grout.

Compared with traditional epoxy adhesives, KERAPOXY has the advantage of being able to be used in particularly damp conditions, which helps eliminate problems typically encountered with traditional adhesives associated with the lengthy installation times required and the need to operate on substrates with more than 4% residual moisture content, while guaranteeing excellent adhesion.

To guarantee a perfect bond of the various ceramic elements inside the sewer channels, KERAPOXY was applied using the double-buttering method to eliminate any gaps or voids between the elements.

The joints were grouted, again using KERAPOXY, at least 12 hours after the installation operations. Because of the properties of the product, solvent does not need to be used to finish off joints and to clean tools: an undeniable advantage when carrying out these operations in a confined area such as that of a sewer network.

Because the work was carried out in different stages, to restore the waterproofing capacity of the expansion joints, MAPEBAND FLEXROLL membrane was applied and bonded in place with ADESILEX PG4.



3. To guarantee the waterproofing capacity of the expansion joints, MAPEBAND FLEXROLL membrane is being applied and bonded in place with ADESILEX PG4.

4. The ceramic covering on the lower surfaces of the sewer channels is being installed and grouted with KERAPOXY mortar.



Find out more
MAPEGROUT EASY FLOW

TECHNICAL DATA

Sewerage network,
Zurich (Switzerland)
Year of construction: 1953
Period of repair:
2022-ongoing
Owner: Zurich
underground works
authority, Zurich recycling
and waste management

authority
Design: Hunziker
Betatech, Ingenieure
Main contractor: Jak.
Scheifele AG
Mapei coordinator:
Maurizio Barletta, Mapei
Suisse (Switzerland)

MAPEI PRODUCTS

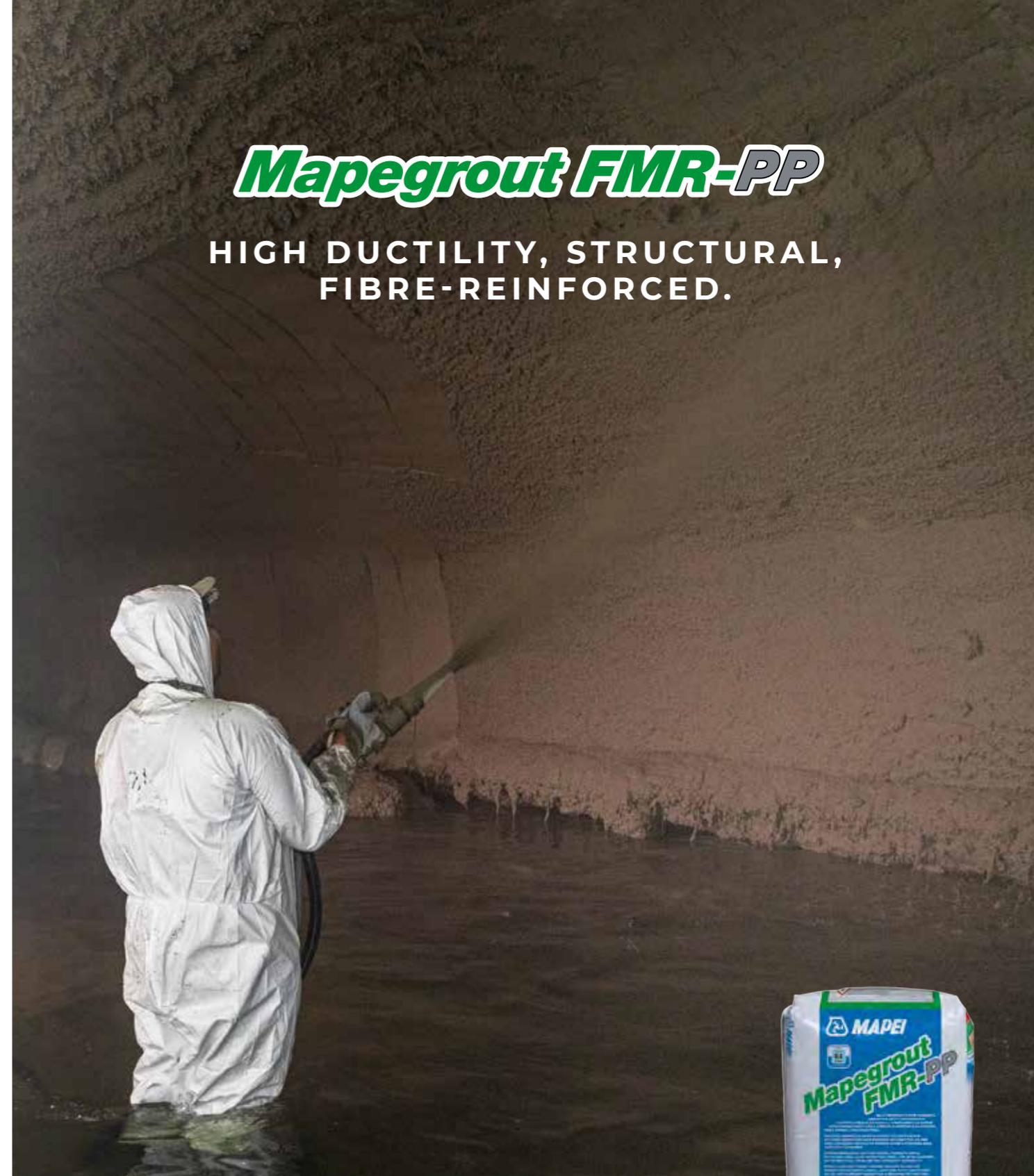
Repairing concrete elements:
Mapegrout T60,
Mapegrout Thixotropic,
Mapegrout Easy Flow
Finishing concrete surfaces: Monofinish HD,
Mapefinish HD, Triblock
Finish
Installing and grouting

ceramic coverings:
Kerapoxy
Waterproofing expansion joints: Mapeband Flexroll,
Adesilex PG4

For further info on
products: mapei.com,
mapei.ch

Mapegrout FMR-PP

HIGH DUCTILITY, STRUCTURAL,
FIBRE-REINFORCED.



Mapegrout FMR-PP is a special mortar reinforced with structural polymer fibres that improves the behaviour of repaired concrete elements. Adheres perfectly to vertical and horizontal surfaces, as well as to ceilings, for quick, impeccable and long-lasting repairs.

EVERYTHING'S OK
WITH MAPEI

Learn more on mapei.com



Fort Wayne (Indiana, U.S.A.)

Three Rivers Protection & Overflow Reduction Tunnel

MAPEI UTT PRODUCTS CONTRIBUTED TO A PROJECT AIMED AT REDUCING COMBINED SEWAGE OVERFLOWS

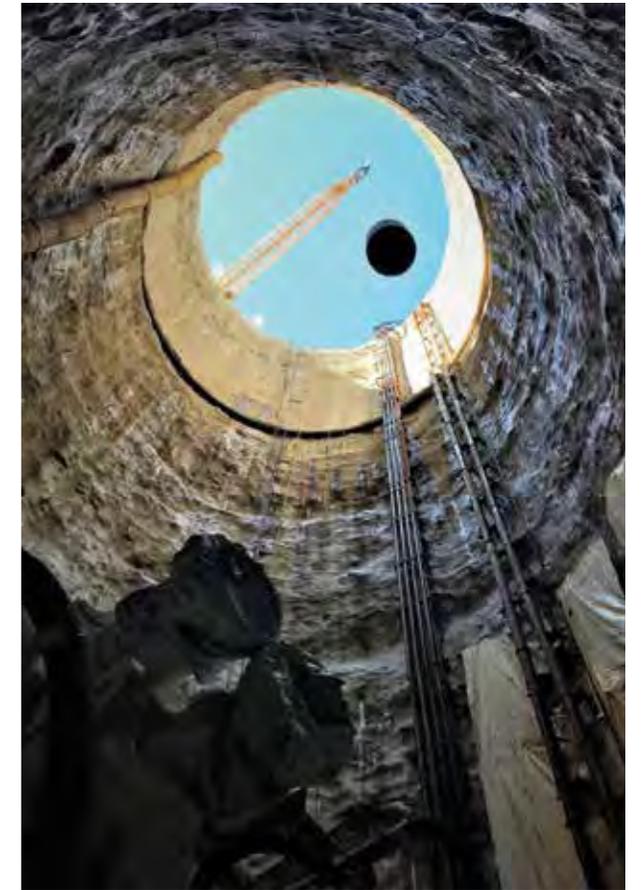
The Three Rivers Protection & Overflow Reduction Tunnel (3RPORT) is a major portion of the effort to clean up Fort Wayne's rivers and protect neighborhoods from basement backups and street flooding. This project is crucial in reducing the number of Combined Sewage Overflows (CSOs) events caused when heavy rains overwhelm the combined sewage and stormwater system and result in untreated discharges into the St. Marys, St. Joseph, and Maumee Rivers. Fort Wayne City Utilities has thus designed Tunnel Works, a large tunnel and network of pipes which extends through the bedrock 75 m below the city. This tunnel system will collect and redirect sewage from the

combined sewer system to the sewage treatment plant. Tunnel Works is the City's main project for reducing the amount of diluted sewage discharged into the rivers. The 3RPORT project includes consolidation sewers, nine drop shafts, and a deep rock tunnel to collect and convey Combined Sewer Overflows (CSOs) from 22 outfalls along the St. Marys and Maumee Rivers. The tunnel has a life expectancy of 100 years. The tunnel has a length of 7.480 m, an internal diameter of 4.87 m and was excavated by means of a Herrenknecht slurry shield TBM with boring diameter 5.81 m which was designed to operate with a support pressure of up to 6.5 bar.

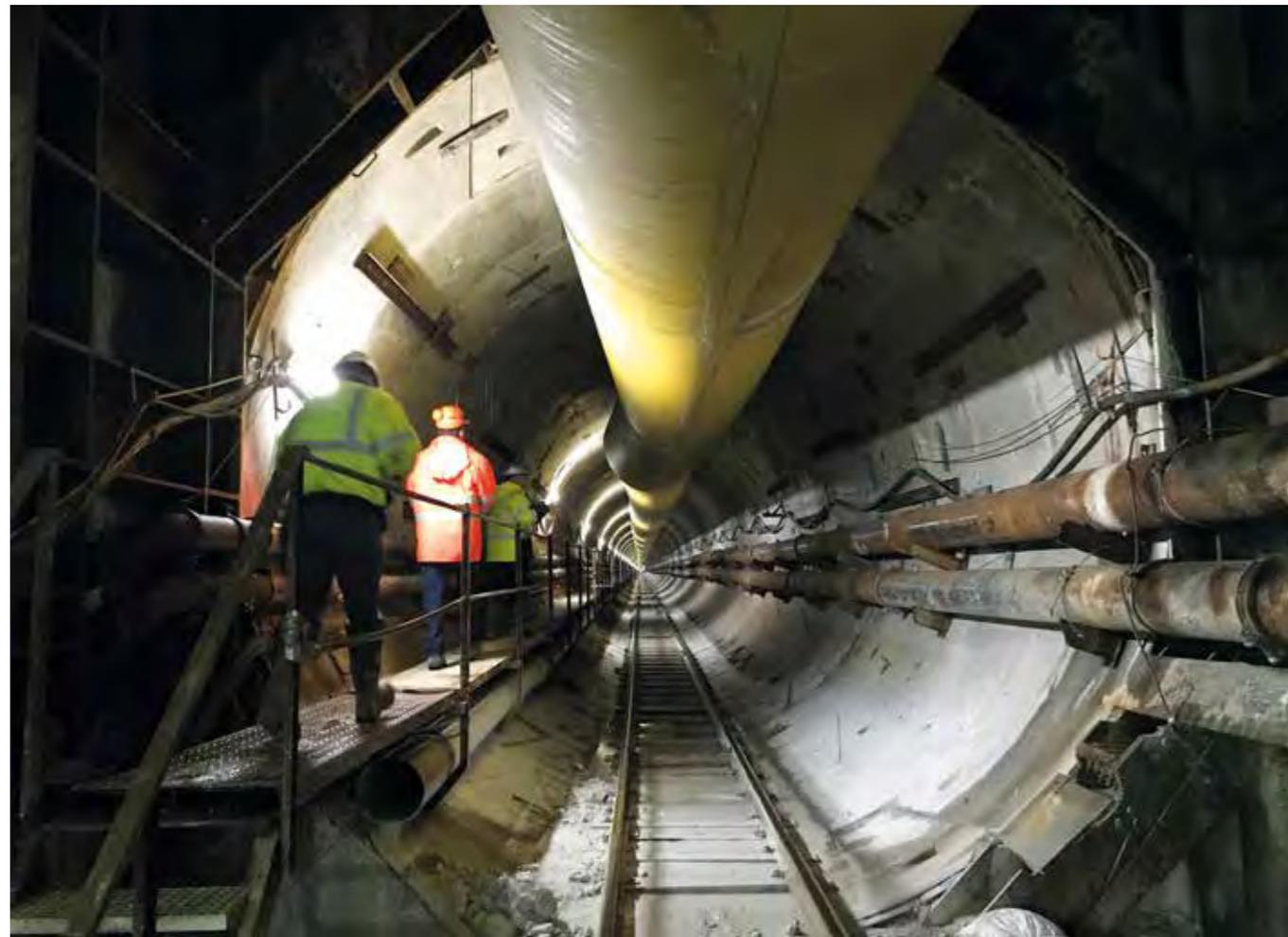
Due to the presence of open vertical and horizontal discontinuities, the hydraulic conductivity is expected to be extremely high, making the management of the water inflow during advance and during standstill the greatest challenge for the contractor.

Mapei products for different uses

Mapei products were used for several kinds of applications during tunneling works. Some of them, like EPOJET LV, PLANITOP 12SR, and PLANITOP 18 were used for repairing concrete elements; others like CABLEJET, MICROCEM 12000, RESFOAM SS 75, RESFOAM HBA 5, RESFOAM 1K-M and RESFOAM 1K-M AKS were used for injections to improve the properties of the ground, stop water leakages, improve internal cohesion, anchoring, bolting, etc. MAPEBENT API 5 and MAPEFLOCK 10 were, on the other hand, used to prepare slurries to help the TBM excavation operations; MAPEQUICK CBS SYSTEM 1 NA, MAPEQUICK CBS SYSTEM 2, MAPEBENT CBS 5 were used as back-filling grouts for TBM operations. MAPEBLOX T was used as a tail sealant and continuously pumped during the TBM advance, in order to seal the tail brushes and to prevent inflows of water, mud, grout, etc. through them into the TBM working area.



IN THE FACING PAGE. The 3RPORT project includes a deep rock tunnel to collect and convey Combined Sewer Overflows (CSOs) from 22 outfalls along the St. Marys and Maumee Rivers. **ABOVE.** One of the shafts included in the 3RPORT project.



Find out more
MAPEQUICK CBS SYSTEM 2

TECHNICAL DATA

Three Rivers Protection & Overflow Reduction Tunnel (3RPORT), Fort Wayne (Indiana, USA)
Period of construction: 2018-2021
Owner: City of Fort Wayne, Indiana
Main contractor: Salini-Lane Healy
Period of the Mapei intervention: 2018-2022

Intervention by Mapei:

supplying products for TBM tunneling operations and concrete repair
Mapei coordinators: James Pinkley, Cristina Oñate, Tanner Murt, Mapei Corp. (USA)

MAPEI PRODUCTS

Concrete repair: Epojet LV, Planitop 12SR*;

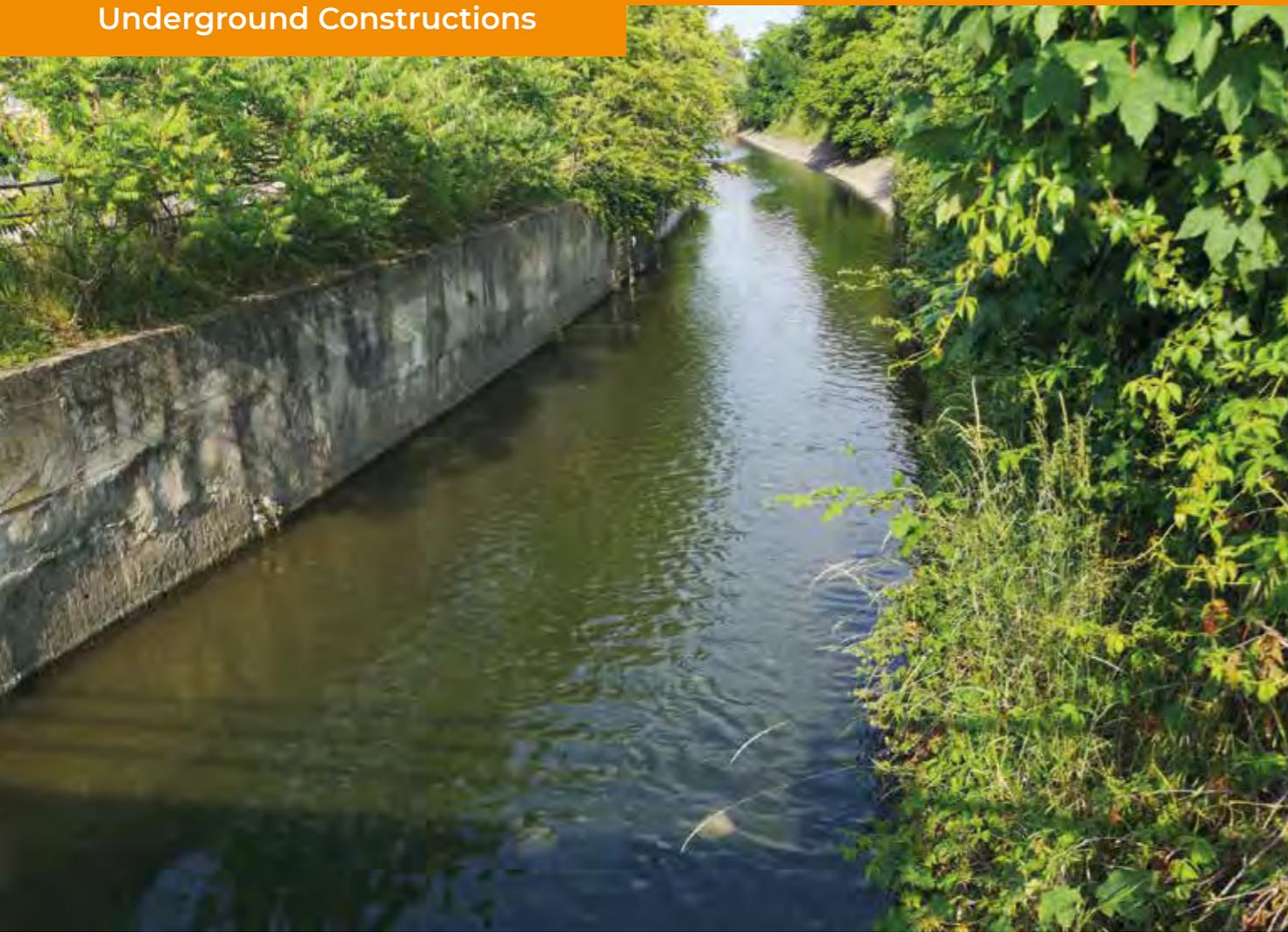
Planitop 18*

Injections: Cablejet, Microcem 12000, Resfoam SS 75*, Resfoam HBA 5*, Resfoam 1K-M, Resfoam 1K-M AKS
Slurries for TBM: Mapebent API 5*, Mapeflock 10,
Back-filling grouts for TBM operations: Mapequick CBS System 1 NA*, Mapequick CBS System 2, Mapebent CBS 5

Tail sealant for TBM: Mapeblox T

*These products are manufactured and distributed on the US market by Mapei Corp., a US subsidiary of the Group.

For further info on products: mapei.com, utt.mapei.com



Milan (Italy)

Cavo Redefossi sewer

A BESPOKE FIBRE-REINFORCED MORTAR EMPLOYED FOR CONSOLIDATING A MASONRY CANAL USED AS SEWER

The Cavo Redefossi is a man-made canal that flows mainly underground through Milan, receiving water from the Naviglio Della Martesana canal and River Seveso before flowing into the River Lambro. It probably already existed in Roman times and was rebuilt between 1783 and 1786 by the Austrian government, which decided to re-route the canal to prevent the River Seveso flooding the Porta Romana, Porta Vittoria and Porta Lodovica districts of the city.

The start point of the canal is in the Porta Nuova district, near the Gabelle Bridge. From here, it flows underground through Porta Venezia district in an easterly direction, through the neighbourhoods of San Donato Milanese and San Giuliano Milanese before arriving in Melegnano, where it flows into the Vettabbia Canal and then into the River Lambro.

The Cavo Redefossi canal was roofed over for the 1906 Expo when it was decided to build several new hotels. The

work to roof over the canal included the construction of a supporting wall for the roof running along the centre of the canal, which was made from concrete.

Consolidation works

The Cavo Redefossi sewer is around 2.5 km long and is one of the many hidden underground passages in Milan. To ensure the water is able to flow freely without obstruction, including in periods when the flowrate is particularly high, it had become necessary to carry out consolidation and maintenance work.

The walls of the canal had become unstable and had cracks which had spread to the vaulted ceilings, due to the effect of mechanical action of the loads and stresses generated by the traffic passing above. There was also evidence of leaching phenomenon, that is, the water flowing along the canal had dissolved the soluble substances present in the ground and the mortars the water had

come into contact with. It was essential, therefore, to carry out significant repair work on the vaulted ceilings, the piers and the bed of the canal.

Mapei proposed MAPEGROUT FMR-PP, a thixotropic, fibre-reinforced mortar used to repair and strengthen concrete structures, and ideal in those cases where, apart from a high level of ductility, good resistance to sulphates and alkalis is also required, such as in repair work on sewer systems and tunnels. Thanks to its structural polymeric fibres, it maintains its high resistance to flexural loads and stresses even after the onset of cracking in the cementitious mortar.

To repair the vaulted ceiling, the first step was to hydro-scarify the surface to create a solid, resistant and rough substrate. The substrate was then saturated with water. Once the water had evaporated off, a layer of MAPEGROUT FMR-PP was applied by spray. Once this layer had dried, steel mesh was applied on the surface and then covered with another layer of MAPEGROUT FMR-PP for a total thickness of 20 cm.

The new vaulted ceiling, repaired as described above, is now able to absorb all the structure's static loads.



Find out more
MAPEGROUT FMR-PP

IN THE FACING PAGE

Cavo Redefossi canal was built in 1783-1786 in Milan and lately consolidated and repaired.

1. Repair works started by hydro-scarifying the substrates to ensure perfect adhesion of the following layers.
2. Installing the steel mesh between the two layers of MAPEGROUT FMR-PP.
3. Applying MAPEGROUT FMR-PP by spray.



TECHNICAL DATA
Cavo Redefossi sewer,
 Milan (Italy)
Design: Pietro Parea
Year of construction: 1783
Year of the Mapei intervention: 2022
Intervention by Mapei: supplying products to

repair the vault and the bottom of the water channels
Design for repair works: Matteo Ghia
Owner: MM S.p.A. - Milan City Council
Works Director: Franco Galli

Contractor: Sca.ma Strade srl
Mapei coordinators: Massimo Seregni, Federico Laino, Luca Pretini, Carlo Pistolesi, Paolo Banfo, Technical Services, Mapei SpA (Italy); Alessio Chierigato and Davide

Michelis, UTT Technical Services
MAPEI PRODUCTS
 Concrete repair: Mapegrout FMR-PP
mapei.com

San Felice Circeo (Province of Latina, Italy)

Polystrada membrane on top of sewer systems

A BITUMINOUS MEMBRANE BY POLYGLASS WAS USED TO REPAIR ROAD SURFACES AFTER COMPLETION OF THE SEWER LINE



TOP OF THE PAGE, LEFT. Installing POLYSTRADA SA membrane on the road surface.

ABOVE. Excavating works for installing the sewer system.



A new sewer line has been constructed for the local water supplier Acqualatina in San Felice Circeo in the Province of Latina (Central Italy) by installing two gravity-flow collectors and a pumping station with delivery pipes. Users from the catchment area where the work was carried out were then tied into the main pipelines. To position the new sewer pipes, and the branch pipes towards the various users, a series of fixed-section trenches had to be dug out.

After back-filling the trenches with appropriate materials, the road surface was reinstated by applying a completely new bituminous conglomerate package consisting of an 8 cm binder layer and a 4 cm wear layer. To limit the risk of settling and sinking due to the difference in stiffness between the areas where work had been carried out and the adjacent areas left intact, a strengthening system was also installed.

An innovative membrane

When reinstating the road bed and surface, POLYSTRADA SA bituminous membrane was also included. POLYSTRADA SA is an elastomeric prefabricated geomembrane comprising a dual self-adhesive bituminous compound, reinforced with a non-rotting environmentally sustainable polyester mesh and fiberglass. This special reinforcement provides excellent dimensional stability and elastic properties resulting in resistance to static and dynamic loading. It ensures good workability on site, guaranteeing easy and rapid installation. It is part of the family of products incorporating ADESOS® technology, an innovative self-adhesive compound that delivers excellent adhesion to all surfaces along with remarkable longevity. The bond between the membrane is strengthened further by the heat of the asphalt pavement and under the effect of traffic and sunlight. The membrane was installed in June, 2022, over an area of 7,000 m² and was inserted between the binder layer and wear layer of the road surface.

TECHNICAL DATA

New sewerage network, San Felice Circeo (Italy)
Period of the intervention: 2021-2022
Intervention by Polyglass: supplying a waterproofing membrane
Owners: Acqualatina Spa and San Felice Circeo City Council
Road repair works: Edil Tecnocostruzioni di Iovine Nazario
Mapei coordinators: Federico Ancillotti, Domenico Caprio, Savino Seccia, Mapei SpA (Italy) and Ines Antunes, Polyglass SpA (Italy)

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Investment plans to explore new markets

WE SPOKE WITH EMANUELE DELLA PASQUA, CEO OF VAGA



Emanuele Della Pasqua, CEO of Vaga.

Vaga produces silica sand and other materials for the building industry. What are your main product lines and in which sectors of the building industry are they used?

- Our main product lines are fundamentally three:
- Pre-dosed and Pre-blended lines: products aimed at the general building and residential sectors, for renovation work and new builds, with a series of pre-blended products dedicated to infrastructures in land-based, rail and maritime environments.
 - Damp Aggregates and Dry Aggregates line: a series of products aimed at manufacturers of pre-blended products, pre-cast concrete companies, ready-mixed concrete plants, the cement industry in general and the sport & leisure sector.
 - Special Aggregates line: a series of products and solutions for the construction industry and special industrial applications, such as sandblasting, industrial filtration systems and water-blasting jets.

The Italian market is crucial for Vaga. Which overseas markets are you targeting to strengthen the international dimension of the company?

Because of the types of solutions we trade in, there are undoubtedly certain overseas markets where it is worth focusing our attention. I am referring to France, Switzerland, Austria and Croatia in particular: in some of these countries we have already established promising collaborations with local distributors. Also, we are looking to exploit the synergy with our parent company, Mapei, to manage overseas collaborations with several Group subsidiaries, such as Mapei Inc. in Canada.



Vaga owns a plant in Costa De' Nobili and four quarries in the Provinces of Pavia and Piacenza.

In order to be competitive, it has become increasingly important to invest in research and innovation. What does this mean for a specialised company such as Vaga?

We have our own Research & Development laboratory that we are currently extending, and we are investing in new equipment to facilitate the work of our team of highly competent researchers, all with considerable experience in our sector. We always strive to maintain an open dialogue with Mapei when it comes to the



supply of dry sands to meet the parent company's needs, and also with regards to the formulation of products for the building industry. But I am convinced that, in certain cases, knowledge needs to be looked for in its main incubators: universities.

This is why we are currently collaborating with the University of Parma and, in the past, we have undertaken important collaborations with Milan Polytechnic and the University of Pavia. The fields of research involved include product performance evaluation and consultancy in the research and development sector.

More recently we have been focusing on research into specific waste products and by-products that could be used in our products or proposed to our clients as aggregates that are compliant with the requirements of CAM (Minimum Environmental Criteria, which in Italy are mandatory for public projects) and CE-certified for specific uses.

Large-scale works and sports facilities are at the centre of important investment programmes: does this also represent an opportunity for Vaga?

Yes, absolutely. The constant synergy with Mapei allows us to be present as a partner or direct supplier on a number of infrastructures sites. So, we produce

graded gravel that is added to certain Mapei mortars so they can be adapted to specific site requirements, or we create pre-blended, finished products on behalf of our parent company; but we are also appreciated and renowned as a direct supplier: our range of

concretes is used on many sites where particularly high and specific performance properties are a requisite and the recent expansion of our aggregates lines enables us to propose these products to sites, offering opportunities in terms of environmental sustainability.

“The new mixing and packing plant will increase our production capacity and open new opportunities for growth

What is envisaged in the investment plan from a production perspective?

Installation of a new mixing and packing plant is ongoing, which will increase the production capacity of various lines of pre-dosed products and enable us to pack pre-blended products in plastic bags. I am convinced this plant will give us further opportunities in terms of development and penetration into new markets. Investments to promote sustainability are also continuing: we are about to complete the revamp of our cogeneration plant and we are looking into the installation of a photovoltaic plant.

What impact does Mapei Group's commitment to sustainability and a circular economy have on Vaga?

Summarising what I said previously, a lot of our effort from a Research & Development perspective is focused on the principles of a circular economy, looking for or (in the future) creating aggregates that can be qualified (CE-certified) for use in our products as well as in Mapei products. Also, we adopt all Mapei Group's management policies to implement, and foster, an increasingly sustainable modus operandi within the company. And this is another reason why Vaga is included in Mapei Group's Sustainability Report.

“The synergy with Mapei allows us to be present on a number of sites but we are also appreciated and renowned as a direct supplier

Quarrying consumes an awful lot of energy. What solutions has Vaga adopted to promote energy efficiency and diversify its energy sources?

We have already talked about the co-generation plant which, by being implemented within our sand-drying production system, is the best tool to optimise yield and convert the entire heating value of fuel into useful energy. Because of the current energy crisis and the difficulty in sourcing fuel, we have already launched a project to feed the drying plant with an alternative type of fuel and planned the installation of a photovoltaic plant.

15.8
MILLION EUROS
TURNOVER IN 2021

17
MILLION EUROS
EXPECTED TURNOVER IN 2022

50
EMPLOYEES

1
PRODUCTION SITE
IN COSTA DE' NOBILI (PAVIA)

4
QUARRIES
IN THE PROVINCES OF PAVIA AND PIACENZA

1,200
TONNES/HOUR OF DAMP SAND

70
TONNES/HOUR OF DRY SAND

800
TONNES/DAY OF PRE-BLENDED AND PRE-DOSED PRODUCTS
PRODUCTION CAPACITY

80 YEARS OF EXPERIENCE IN THE EXTRACTION AND PRODUCTION OF MATERIALS FOR THE BUILDING INDUSTRY

1940-1979

From manual extraction to the first mechanised extraction equipment

The company's history began in the Province of Pavia in the 1940's with the acquisition of Cooperativa Concordia, which was renamed "Cava del Po" in 1968. The evolution in extraction technology meant that operations normally carried out manually (with shovels) progressed to the use of mechanised equipment, such as draglines and dump trucks.



1980-1986

The founding of Padana Inerti and a stop to extraction operations

In the 1980's new regulations for the Po River meant that excavation work could only be carried using mobile boats and watercraft. Cava del Po was renamed "Padana Inerti". As extraction technology evolved even further (with the introduction of dredging pumps and semi-mobile ground-mounted equipment), at the end of the 1980's a stop was put on riverbed extraction: alternative extraction sites had to be found to source the amount of aggregates required to meet the growing demand from the building sector and from industry in general.

1987-1990

The River Po is abandoned to extract material from floodplains

Extraction from the bed of the River Po was finally abandoned in 1987 in favour of extraction from floodplains. During these years the company invested heavily in new technologies that radically changed how aggregates were extracted and sold. At the beginning of the 1990's the facility transferred a few kilometres north to Costa De' Nobili to exploit availability from the local floodplains.



1990-2000

A process of diversification is launched

A process of diversification of the company's operations was launched in these years: extraction, washing, damp grading, drying, storage or packing in plastic bags. Thanks to considerable investments, Vaga started commissioning an industrial plant for the primary treatment and, afterwards, the upgrading of the quality of raw materials through a washing and packing process. This enabled the company to optimise industrial costs and extend the range of products offered.

2000-2008

With Mapei around the world

In 2000 Vaga S.r.l. became part of Mapei Group, which uses its materials as raw materials in many of its products for the building industry. And for Vaga this is a gateway to new opportunities: it became even easier for its products to reach international markets.



2009-today

New product lines and commitment to the environment

In 2009 Vaga launched a new phase: the production of materials for the building industry. This led to the development of new product lines: the mortars line with traditional cementitious products such as MaltaBASTARDA and lime-based BIO products; the screeds line such as SabbiaCEMENTO, and the concrete line with products such as CALCESTRUZZO RCK40. The company also increased its commitment to sustainability: apart from reducing the impact of its activities and processes on the environment, in 2022 the company launched new lines of eco-friendly abrasives for special applications (GreenGarnet, Greenjet and Greentex) and aggregates (SANDEX and GRAVELEX).



Products in the name of research and innovation

A COMPREHENSIVE RANGE FEATURING SAND, MORTARS FOR BUILDING AND MATERIALS FOR SPORTS SURFACES

Behind all Vaga's activities there is constant attention on the research and the development of new products that are able to meet the needs of a sector, such as that of construction, in continuous evolution. After being the first to introduce polypropylene fibres to the pre-blended rendering mortars market, in recent years Vaga's commitment to Research & Development has brought to the formula-

tion of cutting-edge solutions such as FIXIA polymer sand for grouting, MASTER ASFALT cold-applied conglomerate (the only one made with SBS modified binder), DRENO concrete for draining paving in public settings and product lines featuring pre-blended, "ready-to-use" rendering and screed mortars. Apart from carrying CE marking and coming with an EPD (Environmental Product Declaration), many

of the products by Vaga comply with EN 140-8 standard regarding the reduction of noise caused by footsteps or have been awarded REI 180 certification of compatibility for their resistance to fire. Objectives the company has been able to achieve thanks also to collaborations with internationally renowned research institutes such as the Department of Structural Engineering at Milan Polytechnic, the

University of Pavia, the construction materials research laboratory at the RINA certifying institute and the Mapei Research & Development Centre in Milan. Vaga's current product range is divided into four main categories: pre-blended products (which include mortars, screeds, concrete and service products); sand, gravels and aggregates line; sports systems; ornamental pebbles.

Pre-blended products....

Mortars



Screeds



Concrete



Service products



...and other lines

Sand, gravels and aggregates



Sports systems



Ornamental pebbles



FROM PRODUCTION TO ENERGY: A COMMITMENT TO THE ENVIRONMENT

Vaga has always operated in a natural environment: initially extracting sand from the bed of the River Po in Northern Italy, before moving on to nearby floodplains. And it is also because of this proximity to natural environments, and in line with the principles of Mapei Group, that the company is committed to pursue sustainability in each and every part of its activities: from the selection of raw materials to production processes, from energy consumption to the development of new products, right up to the certification of materials and operations.

Vaga is committed to reducing energy consumption and containing CO₂ emissions, as it is all too aware of the considerable amounts of energy required for its production processes. Research is carried out constantly to find alternative solutions to traditional energy sources, such as exploiting co-generation options, and the impact its activities have on the environment is constantly monitored with the aim of reducing it during extraction and drying processes, investing in environmental recovery and carbon offsetting initiatives, such as the 100-hectare poplar wood at the "Le Gerre" quarry in Belgioioso (Province of Pavia).

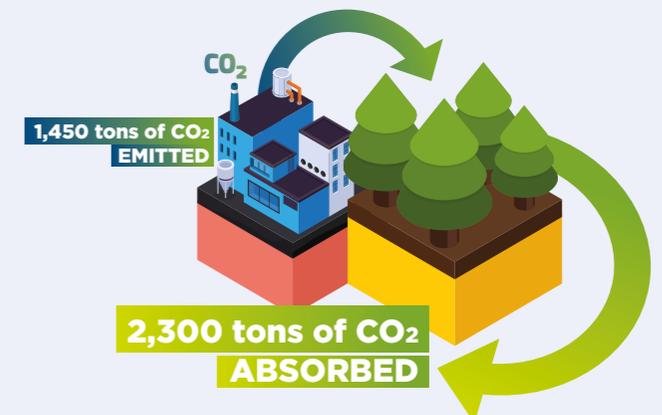
The company also collaborates with universities to identify different aggregates to those extracted from quarries, thereby reducing exploitation of natural resources. The project also involved companies looking for ways of reusing waste products from their production processes. The result is that alternative sources of aggregates have been identified, derived from either secondary raw materials or carefully graded waste products, and Vaga has asked authorisation for a plant to treat and convert waste material into secondary raw materials.

The aim of the Research & Development work carried out by Vaga is to create products that are increasingly eco-sustainable and made using high quality raw materials with high performance properties. They come with CP DOC 262 certification and a declaration of their procurement distance or comply with EN ISO 14021 regarding their recycled content. For instance, the company lately developed the new line of silica-free and eco-friendly synthetic abrasives for special applications (Greentex, GreenGarnet and Greenjet) and the SANDEX and GRAVELEX ranges of ecological aggregates derived from the processing of low-alloy steel in electric arc furnaces. All the products from these lines come with an EPD (Environmental Product Declaration) approved by the internationally recognised body, The International EPD System.

Vaga applies "BIO" marking to all those materials from its building products line made exclusively from high quality raw materials and which are particularly suitable for eco-sustainable buildings projects. MaltaBASTARDA, FIBROMALTA, CALCESTRUZZO, DRENO, SabbiaCEMENTO and TurboMASS also come with a declaration mentioning that they contribute points to achieve LEED certification for sustainable buildings.



THE VIRTUOUS CIRCLE

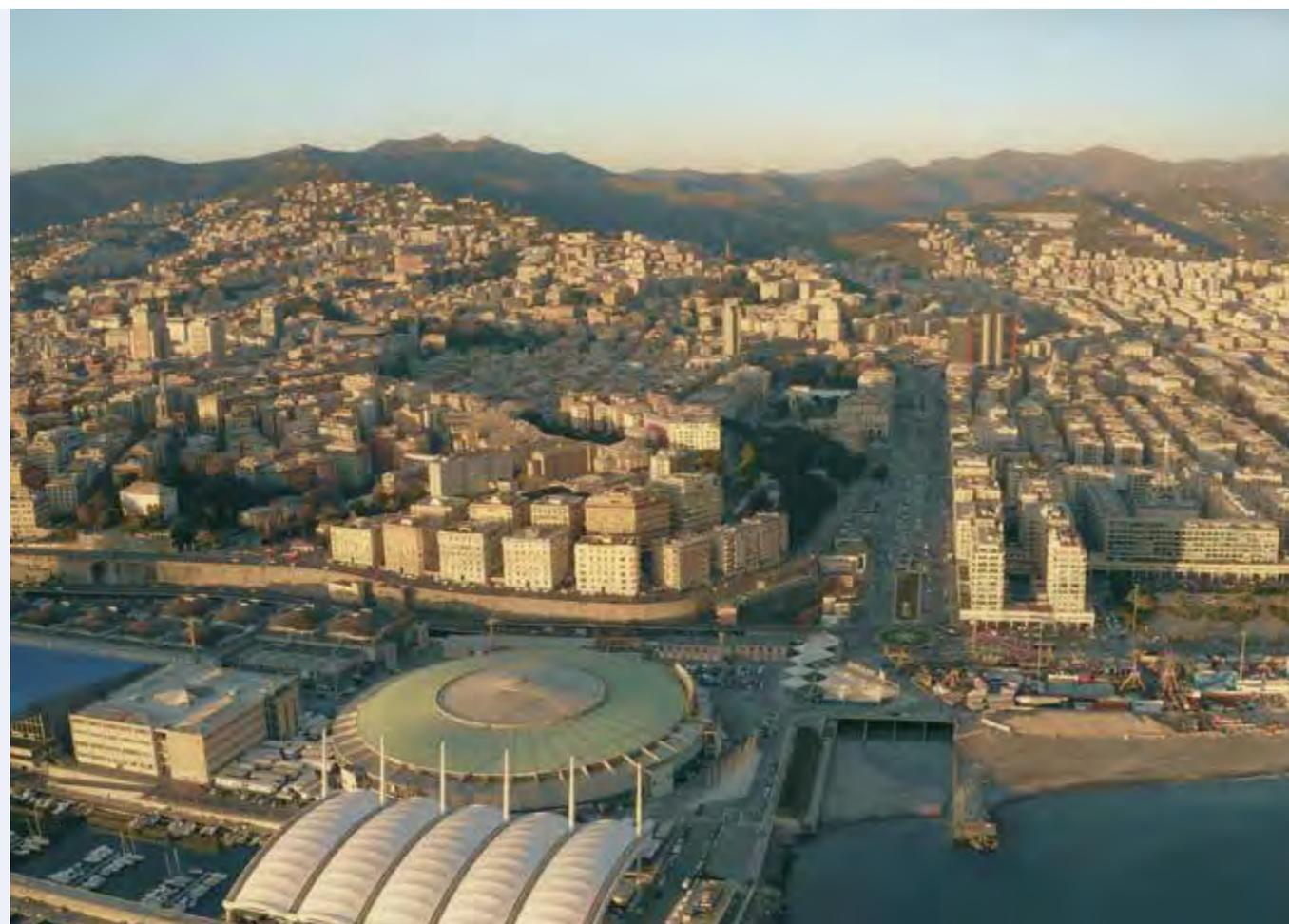


Vaga invests in offsetting CO₂ emissions related to its manufacturing operations in several ways and by managing a 100-hectare poplar grove.



From sport facilities to beaches

A SERIES OF PROJECTS CARRIED OUT WITH VAGA SOLUTIONS



Indoor sports arena, Genoa (Italy)

The refurbishment of this sports arena was included as part of the “Waterfront Levante” project designed by Renzo Piano Building Workshop to develop and repurpose an area of Genoa much loved by local residents and tourists. Thanks to an investment of 94 million Euros, the arena will be able to maintain its

sporting vocation and, in addition, will also feature new spaces dedicated to shopping and fitness. Work on the arena started in 2021 and, in June of the same year, included structural strengthening work by reintegrating the section of various pillars. BEtonFLuid self-compacting concrete (SCC) by Vaga was used in the formulation for the concrete mix.



Mapei Stadium Reggio Emilia (Italy)

Last summer, between the end of June and the middle of August, the Mapei Stadium underwent substantial refurbishment work, which involved not only the installation of new smart turnstiles and roofs for the East and West stands, but also work on the pitch. Thanks to MAPE-SOIL technology, which was installed back in 2014, the drainage system under the pitch did not need any attention, whereas the sub-base of the pitch was renovated using Vaga products such as VG SPORT WE 1, VG SPORT WE 10 and VG SPORT SE 06. These are washed, graded natural aggregates which, thanks to their high drainage capacity, are particularly suitable for use in sports facilities and approved for application on pitches in natural grass.

Amplifon Head-Office Milan (Italy)

The new head-office of the multinational Amplifon, leader in the distribution of hearing aids, is located in a building constructed in the 1990's which has been completely refurbished according to a design by the architectural studio, 967arch. Apart from reorganising and optimising the building's internal spaces, the paving in the external areas also played an important role in “constructing” the new look the company wishes to portray. Vaga also contributed to the work carried out on the paving by supplying TurboMASS pre-blended, fibre-reinforced, cementitious screed mortar which, thanks to its rapid-drying properties, enabled work to be completed very quickly.



Former Santa Margherita Nuova Monastery, Procida (Province of Naples, Italy)

In 2021 the former Santa Margherita Nuova Monastery, perched on rocks with a sheer drop to the sea around Procida, was given a new lease of life thanks also to the island being nominated Italy's Capital of Culture for 2022. It has been transformed from an historic religious building into a cultural and museum hub thanks also to an investment of 3 million Euros and a series of restoration and repair works, which included the use of CALCESTRUZZO Rck40 to structurally consolidate the foundations and walls of the convent. This fibre-reinforced product by Vaga is particularly suitable for use on sites where, as in this case, high performance properties and ease of use are required, due also to the problem of limited access to site by heavy goods vehicles.



Laigueglia Beach Laigueglia (Province of Savona, Italy)

Vaga took part in the project to nourish the beach, which had become necessary due to a series of storms and to contrast coastal erosion, so that the coastline could continue to be used by tourists and local residents. It was decided to use Vaga sand extracted from the quarry at Le Gerre (Province of Pavia) due to it having the same chemical composition and physical and granulometric characteristics as the sand on the beach. The sand was tested and approved by Arpal Liguria (Liguria Regional Environment Protection Agency) as an aggregate suitable for reintegrating beaches.



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TO TRY THEM
TO SEE WHAT
MORE THEY
HAVE TO OFFER



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Chemical industry in decline: warning for the economy

PRESIDENT PAOLO LAMBERTI AT FEDERCHIMICA'S GENERAL MEETING:
"IF OUR SECTOR GRINDS TO A HALT, IT WILL HAVE A KNOCK-ON EFFECT
ON THE ENTIRE ECONOMY"



Paolo Lamberti's speech at Federchimica's general meeting.

The revival in the Italian chemical industry is being jeopardised by the energy crisis. After a positive first half of the year, there has been a sharp deterioration since July. Production is expected to fall by 4% by the end of 2022

After a positive first half of the year (+0.4% in production) in the Italian chemical industry, there has been a gradual decline since July, caused mainly by rising energy costs and weakening demand from customer sectors. The result of this slowdown is the forecast (if there are no restrictions on operations due to gas rationing) of a drop in production of 8% in the second half of the year, which would result in an overall drop of 4% by the end of the year.

This is the scenario of the Italian chemical industry outlined during the general meeting of Federchimica, the Italian Federation of the chemical industry, held in Milan on 24th October that was drawn to a close by the President of Confindustria (the Confederation of the Italian manufacturing and service companies), Carlo Bonomi.

The prospects outlined are not confined to the chemicals industry, because the downturn expected during the second half of the year is a "worrying sign for Italy's entire economy". This is the warning issued

Lamberti: Chemicals are the raw material of almost all manufacturing chains and an essential driver of the economy. Support is needed to cope with the emergency

by the President of Federchimica in his report to the general meeting: "Without the chemical industry," so Paolo Lamberti emphasised, "Italian manufacturing will come to a standstill. Our sector provides the raw materials for almost all manufacturing chains linked, for example, to the food, construction, fashion

and design industries. It is a vital driver for our economy, as well as a technological infrastructure of high quality and innovation. The institutions should take note and provide support measures and packages to tackle the crisis". The energy crisis is in danger of jeopardising the revival of the Italian chemical industry, one of the great strengths of Italian manufacturing. Despite difficulties in 2021, the rapid restart means pre-Covid levels have

already been restored with manufacturing output now having reached a value of 56.4 billion Euros. The Italian chemical industry is the third largest manufacturer in Europe after Germany and France with 2,800 companies employing 112,000 highly skilled staff and creating an overall total of 278,000 jobs if

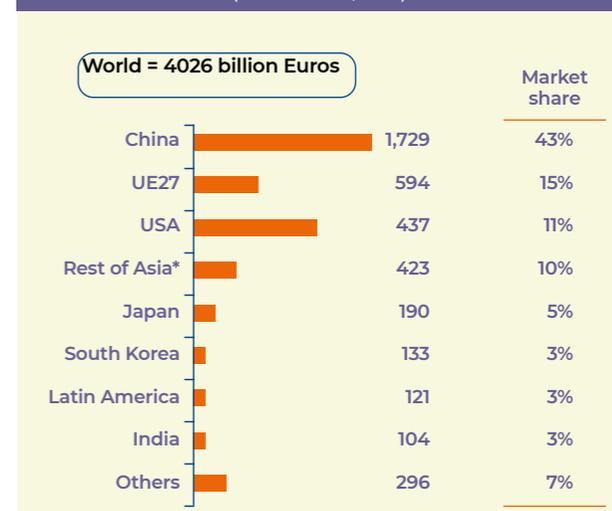
allied industries are taken into account. As President Lamberti emphasised, "the energy shock is having a notable negative impact on competitiveness for the entire European industry, but Italy is also at risk vis-à-vis other EU countries due to its greater reliance on gas".

The chemical industry is, in fact, an energy-intensive sector that also uses gas as a raw material for numerous manufacturing operations: even before the current crisis, the cost of energy had a very high impact (11%) on production costs with even more significant peaks for sectors such as technical gases, fertilisers, base chemicals and lots of active ingredients in pharmaceutical products.

On this front, the Italian chemical industry has been a forerunner because it has long been committed to promoting energy efficiency. Since 2000 it has reduced consumption by 44% for the same manufacturing output, thanks in part to investment in cogeneration, renewables and the circular economy. To cope with the energy crisis, companies are now drawing on every possible measure from reshuffling work shifts to reformulating their products.

Federchimica has warned that, if energy costs remain at the peaks they have reached, certain companies will have to seriously consider halting their most energy-intensive manufacturing operations. There is a real risk that this will have a very negative impact in terms of competitiveness at a very delicate moment when companies are committed to investing in the ecological transition. "We are facing a perfect storm," so Lamberti explained, "with the chemical industry among the most affected sectors because, on the one hand, it is energy intensive and, on the other, it is universally accepted that, along with car manufacturing, it is the industry that will have to adapt most in order to hit climate change targets. When it comes to public decision-making at all levels, the emphasis is almost always placed on the environmental benefits while the costs to industry are inevitably underestimated, only to discover that the opposite is true. This means there is little impact on the environment, but competitiveness takes a big hit". Hence the request to streamline and simplify the bureaucratic-regulatory framework by offering long-term assurances on investment, making sure businesses can maintain their research capacity and avoiding making decisions on the spur of the moment.

GEOGRAPHICAL DISTRIBUTION OF THE OVERALL WORTH OF GLOBAL CHEMICAL MANUFACTURING (billion Euros, 2021)



Rest of Asia: excluding China, Japan, South Korea, and East India
Source: based on figures from Cefic, Chemdata International, and American Chemistry Council, for year 2021

CHEMICAL MANUFACTURING IN EUROPE (billion Euros, 2021)



*The figure includes commercial activities related with the harbor activities.
Source: figures from Cefic, Chemdata International, Eurostat, American Chemistry Council, for year 2021



Cresco Award

MAPEI AWARDED THE PRIZE TO PRATO CITY COUNCIL FOR ITS PROJECT TO REDEVELOP THE CITY RAMPARTS

Once again this year, Mapei took part in the Cresco Award - Sustainable Cities set up by the Sodalitas Foundation in partnership with Anci (the National Association of Italian City Councils) to promote the community sustainability and reward projects by municipal authorities complying with the SDGs (Sustainable Development Goals) on the UN's 2030 Agenda.

This year's Cresco Awards could once again count on a partnership with a group of companies associated with Fondazione Sodalitas, all committed to sustainability (Bureau Veritas Italia, Certiquality, Confida, Enel, FedEx, Gedeon Richter Italia, Intesa Sanpaolo, KPMG, Lexmark, Mapei, Pirelli, Poste Italiane, Saint-Gobain, Solvay, STMicroelectronics). Prizes were awarded to local authorities on specific issues. The Mapei award, dedicated to "Sustainable systems for the conservative redevelopment and restoration of buildings of historical and architectural importance by means of innovative lime-based materials and technologies", was awarded to the City Council of



LEFT. Davide Bandera (left), Mapei's Corporate Product Manager for Restoration systems for historical and modern buildings, presented the award to Enrico Romei, Prato City Council's Officer.

Prato (Central Italy) for the redevelopment project on 'Bastione delle Forche' ramparts. The awards ceremony was held on 23rd November at Bergamo Exhibition Centre during the 39th Anci Annual Meeting. Mapei awarded the prize to the city of Prato's project because it meets the need to restore and repair the community's historic buildings by means of high-quality, eco-sustainable and durable works. The project aims to redevelop one of the sixteenth-century bastions along the fourteenth-century city walls by converting the terrace to be used as a restaurant and renovating the nineteenth-century

building for office purposes. The City Council will benefit from Mapei's specialist technical consultancy during both the design phase - to choose the most suitable products to be used, partly based on laboratory analyses of samples taken on site - and also during the restoration operations using technologies carefully selected to ensure the durability and sustainability of the entire project in compliance with regulations.

A statue from Duomo Cathedral at Mapei



THANKS TO THE 'ADOPT A STATUE' PROJECT, A SCULPTURE FROM THE CATHEDRAL'S COLLECTION IS NOW ON DISPLAY AT THE COMPANY'S HEAD OFFICES IN MILAN

"David with a harp", a 16th-century statue that was once located in the south transept of Milan Cathedral, has been on display in the entrance to Mapei's head offices in Viale Jenner, Milan, since 15th December. It greets staff and visitors thanks to the 'Adopt a Statue' project launched three years ago by the Veneranda Fabbrica del Duomo to raise funds for the protection and enhancement of those cathedral sculptures that can no longer be left on Duomo and are being stored in Marble Workers' Yard awaiting restoration. The project offers business and ordinary people the chance to contribute to their restoration and then exhibit them temporarily (one year and possibly longer) on their own premises.

"David with a harp" is a work dating back to the latter half of the 16th century and depicts a subject from the Old Testament. It represents David, the second king of Israel, who, according to a famous story, was able to soothe the torments of King Saul, his predecessor, by playing melodic tunes on his harp.

"This minor enterprise has a great symbolic value for me, - so on 15th December Veronica Squinzi stated, Mapei's CEO and Member of the Veneranda Fabbrica's Advisory Board - Every day, all of us will pass by this statue on our way to work and proudly remember what Mapei has achieved so far in the name of research, innovation and social engagement. We will be encouraged to keep on helping conserve and pass on our historical, artistic and architectural heritage to future generations".

Back in 2018, Mapei became part of the "Get your spire- Carve your name in history" project, a fundraising campaign launched in October 2012 with the aim of getting local people, businesses and associations from the city involved in the restoration of Duomo's 135 spires (see *Realtà Mapei International* no. 68). Back then, Mapei chose a spire in the form of a young saint over on the north side of the Cathedral's central terrace.

Support underlining Mapei's close ties with Milan that demonstrates that "community spirit", which, as Fedele Confalonieri, President of the Veneranda Fabbrica, recalled, "still lives on thanks to all those supporters who contribute to fund-raising projects" so the Duomo continues to be a symbol of the city all over the world.



ABOVE. From the left, Fulvio Pravadelli, General Manager of the Veneranda Fabbrica del Duomo di Milano, Marco Squinzi, CEO of Mapei, Elena Buscemi, President of Milan City Council, Veronica Squinzi, CEO of Mapei, Laura Squinzi, President of the Mapei's Board of Directors, Monsignor Gianantonio Borgonovo, Archpriest of the Duomo Cathedral.

TOP OF THE PAGE. "David with a harp", a 16th-century statue that was once part of Duomo Cathedral is now on display at Mapei's head offices in Milan.

Autumn trade fairs

BUILDING INDUSTRY, INTERIOR DESIGN, MARINE INDUSTRY:
MAPEI PROPOSALS AT RECENT TRADE FAIRS

SUPERFACES (Rimini, 12th-14th October)

INNOVATION FOR INTERIOR DESIGN AND ARCHITECTURE

Mapei was present at the second edition of this trade fair dedicated to innovative surfaces and materials for interior design and architecture, which drew in 50 brand names and

hosted 9 events dedicated to the sector. To install textile floor and wall coverings, Mapei showcased the TX range, which includes ULTRABOND ECO TX adhesives and ULTRABOND

ECO TACK TX+ non-slip tackifier. The MAPEI DECOR solutions, on the other hand, have been developed for installing wallpaper and decorative fibreglass in new or existing environment undergoing refurbishment, where you wish to improve aesthetics without having to demolish and remove substrates such as existing ceramic tiles. All this even in wet areas like bathrooms and cabin showers.

To install LVT, SPC and rigid LVT, there is the Mapei 4 LVT range. The jewel in the crown of this line is SHOWER SYSTEM 4 LVT: thanks to the innovative adhesive ULTRABOND ECO MS 4 LVT WALL & FLOOR, LVT and SPC can now be applied in showers over existing floor and wall coverings and even on non-absorbent substrates.



SAIE (Bologna, 19th-22nd October)

TECHNOLOGICAL SOLUTIONS FOR THE BUILDING INDUSTRY

The Italian building sector came together at the 55th edition of SAIE, a trade fair targeting the design, construction and plant engineering industry, with an influx of 37,000 visitors. Mapei made its return to the trade fair with a presentation of the latest solutions aimed at the world of building, such as the new Concrete Flooring Solutions (CFS) line dedicated to the

industrial flooring sector. Also showcased at the trade fair were MAPEFILL 130 WT high performance, fluid cementitious mortar for anchoring onshore wind turbines, and MAPEFIX EP 100 pure epoxy resin for structural chemical anchors, including in seismic area. There was also a dedicated space for MAPESCREED, the new range of admixtures



specific for screeds and lightweight substrates, a concrete response to site needs. MAPESCREED admixtures enable screeds to be made

with particularly high mechanical characteristics in environments where the screed needs to be compact or able to withstand heavy loads.

ARCHITECT@WORK (Milan, 9th-10th November)

TECHNOLOGIES FOR LVT

It was an intense two days of proceedings at ARCHITECT@WORK Milan 2022: 3,240 designers attended an event focused on people working in the realms of architecture, building and interior design.

Mapei was present with its range of Mapei 4 LVT products for the installation of LVTs, SPCs and rigid LVT, even in bathrooms, thanks to the innovative adhesive ULTRABOND ECO MS 4 LVT WALL

& FLOOR, particularly suitable for laying LVT in wet areas even on non absorbent substrates. The spotlight was also focused on accessory products designed to cater for contemporary trends: channels, gullies and profiles for showers by Profilpas, a company the Mapei Group recently acquired that specialises in the manufacture and sale of linear shower drains, point drains and profiles for floor-level showers.



METSTRADE (Amsterdam, 15th-17th November)

CRUISE SHIP INTERIORS EXPO (London, 30th November-1st December)

MATERIALS AND SYSTEMS FOR THE MARINE INDUSTRY

From the first edition held in 1988 to the present day, Metstrade has established itself as the largest B2B exhibition of materials and systems for the marine industry: a platform for innovation and networking for the marine leisure industry. The 2022 edition saw a return to its pre-pandemic levels: over three days, 1,400 exhibitors from 49 countries greeted over 17,417 visitors in the ten halls of RAI Amsterdam exhibition centre. Cruise Ship Interiors Expo Europe, on the other hand, is an exhibition dedicated to the latest innovations and trends in cruise ship interior design.

It takes place at London's Excel Centre and, with 250 exhibiting design studios this year, is visited by a large audience of architects, designers, manufacturers and suppliers of materials, technologies and services from all over Europe and beyond. Mapei Marine, one of the Group's subsidiaries,

attended both exhibitions, showcasing innovative and reliable products that help create eye-catching indoor and outdoor settings without sacrificing anything in terms of durability, hygiene and resistance. MAPEDECK line was in the spotlight: it is used to create resin coatings for

elegant and functional surfaces in luxurious ships and yachts. It encloses products such as MAPEDECK TERRAZZO for creating "terrazzo-alla-Veneziana" floorings; MAPEDECK MIRUM, a decorative polyurethane skimming compound, for attractive finishes in vertical/horizontal indoor and outdoor surfaces; MAPEDECK MONODESIGN smoothing and levelling compound for creating decorative coatings with a marbled effect on internal floors and walls; MAPEDECK TEAK EVOLUTION, a self-levelling resin coating for creating floorings with a realistic wood-effect.



Mapei's adventure in blue-water racing gets off to a successful start

AMBROGIO BECCARIA FINISHED SECOND IN THE CLASS40 CATEGORY OF THE ROUTE DU RHUM AFTER BEING PART OF THE LEADING GROUP FOR THE ENTIRE RACE



Ambrogio Beccaria completed an extraordinary feat with his sailing boat supported by Mapei as global sponsor. The Italian came second in the Class 40 category in the 12th Route du Rhum, the most famous transatlantic race in the world with the highest number of entrants, which started at the beginning of November.

An achievement that fills the company with pride and confirms that Mapei made the right choice in supporting his project: Ambrogio's performance in the regatta showed that he perfectly embodies all those values that Mapei puts into practice both in its everyday work and its sports sponsorships: grit, tenacity and strategic ability, even in the face of great difficulties. An attitude perfectly in synch with Mapei's motto: "Never stop pedalling!"

The race, won by the Frenchman Yoann Richomme, started from Saint Malo in Brittany and finished in Guadeloupe in the Caribbean. It was Ambrogio Beccaria's first non-stop transatlantic regatta.

The yachtsman nicknamed 'Bogi' was bursting with joy when he arrived, despite the fact that the competition had been very demanding from both a physical and

mental viewpoint, forcing him to deal with broken sleep, extreme temperatures, endless nights and the constant noise of the sea. Upon his arrival he said: "I have so much adrenalin pumping around my body, because during 14 days of racing you hardly sleep".

Beccaria sailed in a boat called Alla Grande-Pirelli, which he was excited about: "It is so incredibly optimised, more like a plane than a boat, it is so fast. It accelerates quickly when racing at around 15-20 knots and that is due to the exceptional design and construction work. On the other hand, I think it can improve. I am curious to see where we can get".

On the eve of the Route du Rhum, Beccaria had been very cautious: "No one imagined that I would come second as a rookie in such an important event. However, deep in my heart I knew I could do it, I even dreamed of winning, although I was aware of the enormous difficulties I would be facing".

There were three crucial moments in the Route du Rhum: "First the start, given the number of boats taking part. I got away well and then kept at the front of

the race. The third section and final Alesei stretch were tricky. The latter was tough physically and very difficult mentally".

The sailor sponsored by Mapei told us about the last night of racing towards Guadeloupe: "It was the most incredible night of my life; my instruments had not been working for days and so I had to be at the helm a lot. I also feared everything would break when I hit the waves".

The challenge between Beccaria and Corentin Douguet was one of the main events of the Saint Malo-Guadeloupe race. "Our personal battle," Beccaria pointed out, "went on for ages. Corentin sailed really fast, but near Guadeloupe I managed to overtake him. In the decisive stretch I gained a lead at least three miles over him, a margin that allowed me to beat him to the finish line".

To support the yachtsman during the regatta, Professor Fabio Volonté, who works with Mapei Sport, had taught Ambrogio key self-medication techniques and provided him with medical assistance for the duration of the regatta with the help of a remote connection.

Facts & figures about Ambrogio's race

3,542 miles
THE DISTANCE FROM SAINT-MALO TO POINTE-À-PITRE

14 days, 7 hours, 23 minutes and 48 seconds
THE TIME THE REGATTA TOOK

11.77 knots
AVERAGE SPEED

12.9 m
LENGTH OF THE BOAT

4.49 m
WIDTH OF THE BOAT

Ambrogio Beccaria's ship log

Despite storms and extreme sea conditions, which would have led many skippers to abandon the race, Ambrogio Beccaria managed to defy the elements and steer Alla Grande-Pirelli to the second step on the podium of the Route du Rhum. Let's set sail with him on an extraordinary Atlantic crossing.



Day 3
Being a sailor doesn't just mean adjusting the sails properly, but also knowing how to solve the thousands of problems that crop up on board.

Day 4
The weekend was all 'rock n' roll'. I broke both sensors. As a result, the automatic pilot stopped tracking the wind, depriving me of precious sleep.

Day 1
Saint-Malo, Wednesday 14th November at 14.15: departure! After a long wait, the moment has finally come. I look out at the horizon and...I hope the wind is in everybody's sails!



Day 7
Today was a tough day mentally: I felt I was on a real rodeo ride, with the boat touching 20 knots and slamming violently into the waves.



Day 11
A real trade wind hit us today: heat, humidity, flying fishes and salt everywhere! I can't sleep: it's very hot during the day and, as we get closer to the equator, the days get shorter and nights seem endless.



Day 12
Just over 48 hours until the finish. The Trade winds are blowing hard bringing in thick clouds.



Day 14
At 16:38 local time, I crossed the finish line in second place in the Class40 category, crossing the Atlantic in 14 days, 7 hours, 23 minutes and 48 seconds. I never imagined I could have got so far. For me it is, first and foremost, a team success, something we achieved together. A hearty thanks to everybody who was there at the finish line and everybody who made me feel I had their support even from far away.



Mapei France and its clients at the Parade des Class40

A group of 140 clients of Mapei France, the Group's French subsidiary based in Toulouse, got the chance to mingle "behind the scenes" of the Route du Rhum. Aboard a boat reserved for Mapei guests, they set sail from the Gare Maritime de la Bourse in Saint Malo on the morning of 28th October and watched, from out at sea, the "Parade des Class40": all the Class40 boats taking part in the transoceanic regatta paraded across the waters off Saint Malo. Once ashore, guests got to know the Alla Grande team better over lunch at the Brasserie du Rhum. In the afternoon, some guests had the chance to board Alla Grande-Pirelli and look around the boat's features and functions in the company of Ambrogio Beccaria and his team.



© Martina Orsini | Ambrogio Beccaria

The Alla Grande-Pirelli team

- Ambrogio Beccaria
- Bernando Zin - Boat Captain
- Albane Seassau - Trainer
- Pietro Bussolati - Project Manager
- Valentina Pigmei - Communication Manager
- Bianca Bertolini - Deputy Project Manager
- Martina Orsini - Photographer





Mapei and Armani are backing Milan street-basket

FIVE STREET-BASKET COURTS REFURBISHED: BESPOKE DESIGNS CREATED ON THE PLAYING SURFACES USING MAPECOAT TNS EXTREME

From the city centre to the outskirts, street-basket in Milan can now count on five completely refurbished courts. Thanks to an agreement between A|X Armani Exchange and Mapei, the playgrounds in Parco Sempione, the Moravia and Muccioli Gardens (south-west Milan), Via Pitteri (in the eastern area) and in the Barona district of the city have been completely refurbished. The initiative, promoted by A|X Armani Exchange in the role of main sponsor, is for the refurbishment and routine maintenance of the courts until the end of 2024. And so, aesthetics and creativity combine with technology to provide the city with new spaces to play sports, develop and socialise. The surfaces, painted with geometric designs, are durable and provide excellent playing comfort thanks to MAPECOAT TNS EXTREME two-component, rapid-drying, epoxy-acrylic resin in water dispersion protecting the surfaces against the high level of footfall and bad weather, as well as to keep the courts in optimum condition over time. MAPECOAT TNS EXTREME may be applied as a coloured coating on surfaces that need to have high level of slip resistance, including areas open to vehicle traffic and even in wet conditions, and is suitable for refurbishment projects in urban spaces for both sports and other uses.



IN THESE PAGES. Applying MAPECOAT TNS EXTREME epoxy-acrylic resin on the basketball courts in the suggestive setting of Parco Sempione in Milan.



Find out more
MAPECOAT TNS EXTREME



by Marco Ormelli

RESIN COATINGS FOR BASKETBALL COURTS: THE SEARCH FOR BEAUTY

Resin Floor have been operating in the resin flooring sector for more than 50 years. What changes have you seen regarding the requirements of designers and clients over the years?

The approach to resin floorings has changed significantly over the years. In the past this type of flooring was considered to be a simple

coloured coating, whereas today the requirements of designers and clients are far more specific and regard their type and technical characteristics to increasingly meet manufacturing needs and constraints, as well as to reduce downtimes to a minimum for sport facilities.

Traditionally, resin coatings has been used mainly in industrial environments, but now it is also being chosen for other types of setting. What are the advantages of using resin coatings for spor-

ting purposes where performance properties also play a role?

In the multisport sector the aesthetic aspect of resin floors, with increasingly eye-catching patterns and colours, fosters social aggregation and helps bring children and youngsters closer to sport.

In more professional sectors, thanks to the contribution of the Mapei Research & Development laboratories, important results have been achieved such as speed of application, better performance characteristics, playing comfort,

resistance to wear and durability. Characteristics which, combined with the variety of patterns and colours available, play a fundamental role in meeting the constantly increasing demand for this type of flooring.

What challenges did you face when applying resin systems for the floors of the Armani basketball courts in Milan?

The main challenge was to deliver a "complete package", which included the application of both materials

by Polyglass (Mapei Group) and materials from the MAPECOAT TNS line. As far as the application of the resin system is concerned, particular attention was required when creating particular patterns: one of a kind geometric figures in different colours and the first to be applied on basketball courts.

You often work with Mapei. What are the strong points of this collaboration?

Because it is also one of the leading companies in the resin flooring

sector, Mapei is an extremely important partner for us. The strong points of this collaboration are, undoubtedly, technical expertise, the comprehensive range of materials on offer, the incredible availability of the various product managers we are constantly and constructively in contact with during the design phase, and when we carry out the actual work, even of the most complex nature.

Technical Director, Resin Floor Srl

More tests and services for the Italian Ski Team

THE PARTNERSHIP BETWEEN FISU AND MAPEI SPORT HAS BEEN EXTENDED FOR ANOTHER FOUR YEARS IN PREPARATION FOR MILAN-CORTINA 2026

The partnership between the Italian Winter Sports Federation (FISI) and Mapei Sport Research Centre has been extended for another four years in preparation for Milan-Cortina 2026 Winter Olympic Games.

In addition to a service of the highest standard that Mapei Sport has been providing for FISI athletes for two Olympic cycles, as of this year they will be offered an even wider range of special services.

The President of FISI, Flavio Roda, and the Head of FISI's Physical Performance Department, Roberto Manzoni, signed the new contract with the the Chief Medical Officer and Chief Executive Officer of Mapei Sport Research Center, Claudio Pecci, and Ermanno Rampinini, Chief Operating Officer and Head of

Human Performance Lab. Additional tests have been introduced to measure athletic performance; the general health of athletes was assessed from a pre-

New assessment and testing sessions to measure the performance levels of Alpine skiers

ventive perspective and symmetry and control tests were also carried out. As well as the usual two testing sessions, a further session will be arranged at the beginning and end of the summer training season to collect useful data for optimising the skiers' performances.

The tests performed on Italian National Alpine skiers

As has been the case now for over 20 years (the partnership between Mapei and FISI was only interrupted between 2009 and 2012), all Italian National Skiing team's skiers

visited Mapei Sport's laboratories for functional assessments before the start of the 2022/23 World Cup. Among them were multiple world champion Dominik Paris, Sofia Goggia (who on 2nd and 3rd December won two World Cup downhill races at Lake Louise) and Marta Bassino (who on 10th December won the World Cup giant slalom in Sestriere), as well as the most promising young members of the Italian National Alpine Ski team.

Every member of the team undergoes two assessments sessions during the year: one at the beginning of the preparatory period in April-May and one just before the start of the competitive season in October-November. If possible, further assessment testing is carried out during the competitive season to get a snapshot of the athletes' physical fitness around the time of the key events in the competition season.



On 2nd and 3rd December Sofia Goggia, an Elite athlete of the Italian National Alpine Skiing team, won the first two World Cup downhill races of the 2022-23 season at Lake Louise in Canada.

She also reached the highest podium in the second downhill in St Moritz on the 17th of December, a day after a hand surgery due to a fracture occurred the previous day during the race.

Testing involves a series of assessments to measure the physiological qualities considered most important for performance in Alpine skiing. After some anthropometric measurements, athletes perform Functional Movement Screening (FMS). Next, the explosive strength of the lower limbs is measured with vertical jump tests and aerobic power is evaluated through an incremental test performed on a cycle ergometer. Neuromuscular fatigue assessment is also evaluated using a special leg press designed by and named after Professor Mogroni.

Training reduces injury risks

Analysing data collected over the past few years has revealed that injuries and training levels are closely linked. Although there is still a high degree of unpredictability, the number of injuries has fallen, while overall training results have improved. All of this clearly shows that testing is vital for devising the ideal training plans for athletes. One recent study carried out by Mapei Sport highlights the physical and physiological differences between World Cup and European Cup skiers: the former are obviously more experienced and get better results in certain tests they take.

Studies into Alpine skiing

Alpine skiing involves a series of isometric and eccentric muscle contractions with high levels of muscle activation, so having high strength levels appears to play a key role in performance. The results of the comparison study between the World Cup and European Cup skiers seem to confirm the importance not only of high levels of strength and power to compete at the top, but also the need for better levels of specific muscular endurance. Lower levels of muscle fatigability were found in the most experienced World Cup skiers. Another aspect that came under study was the differences between fast and technical disciplines. In the former, top speeds of over 160 km/h are reached in competitions lasting around two minutes, while in the latter, which are held on steeper slopes with very tight turns, the speeds are significantly slower, as is the duration of the races themselves (60 to 90 seconds). The physical demands are therefore slightly different: while in fast races (downhill and supergiant slalom), performance is more close-

New assessment and testing sessions to measure the performance levels of Alpine skiers

ly linked to the ability to maintain the best possible aerodynamic position, the ability to make numerous tight turns in rapid succession is the key factor in the giant slalom and special slalom.

Pre-season training for everybody

For all keen skiers who can't wait to put on their skis, it is very important to remember the role of pre-season fitness training. This type of training serves two purposes: to prevent fatigue-induced 'leg pain' from interfering with your enjoyment on the slopes and to help reduce the risk of injury. To this end, Mapei Sport

has devised a pre-ski season training programme, tailor-made to suit the specific needs of skiers of all levels.

Anyone can take their pre-season ski training to another

level by visiting the Training Department of the Mapei Sport Research Centre, the same facility where skiers in the Italian National Alpine Ski team undergo functional testing.

Giulia De Maio. Mapei Sport



Federica Brignone warms up before taking the VO₂max test.



Alex Vinatzer at the Mogroni eccentric press.

Mapei Football Center: architecture, sport and culture

A BOOK ABOUT MAPEI FOOTBALL CENTER, A FACILITY OPEN TO THE LOCAL COMMUNITY, WAS PRESENTED AT TRIENNALE MILANO EXHIBITION CENTRE



"Mapei Football Center will be a training complex of the highest order in the field of sports facilities, providing support for the first and youth teams and a congregation place for local fans and the surrounding community thanks to all the projects and side events Sassuolo will be organising there". This was what Giorgio Squinzi (Mapei Group's former CEO) had to say back in June 2019 at the official opening of the Sassuolo facility. Everything came true on time. The Mapei Football Center, designed by Onsitestudio in Sassuolo, is now the training venue for Sassuolo's first team that is playing in Italian Serie A for the tenth season running, as well as the women's team that also plays in its top division. Besides, it is also the training ground for the club's youth teams.

But that is not all: the Italian national team has trained at the 'Mapei Center' several times and has used the facility to put the finishing touches to its preparations ahead of important European and World Cup qualifying matches. The facility is also used for social projects to underline Sassuolo's close ties with the local community.



On 8th November, the book Corner Kick, focusing on the Mapei Football Center, was presented at Triennale Milano exhibition centre.



© Filippo Romano

The Mapei Football Center was officially inaugurated in 2019 in Sassuolo and is now regularly used by all Sassuolo teams.

Corner Kick at Triennale Milano

On 8th November, the book entitled Corner Kick, dedicated to the Mapei Football Center, was presented at the Triennale Milano design and art exhibition center. The book includes contributions from many of the people who helped build the facility and traces back the over 100-year history of Sassuolo football club.

The presentation was attended by Veronica Squinzi, CEO of the Mapei Group and Vice-president of Sassuolo, Simona Giorgetta, member of Mapei Group's Board and CEO of Mapei Stadium, and the architects Giancarlo Floridi and Angelo Lunati from Onsitestudio. Sassuolo's President and CEO, Carlo Rossi, and Sassuolo's CEO and General Manager Giovanni Carnevali were also in attendance. "It is nice to celebrate the publication of this book dedicated to Mapei Football Centre right here at Triennale Milano, a place of culture to which we have been linked for so many years," so Veronica Squinzi stated, "together with the people who have contributed to the project. We at Mapei like the combination of sport and culture very much because it represents many of the values found in our DNA: passion, talent, teamwork, enthusiasm and determination in taking on new challenges".

"In the management of the team," so Veronica Squinzi went on to say, "we apply the same philosophy we adopt at the company: we continue to invest in order to achieve long-lasting results. The opening of the Mapei Football Centre was, in this sense, an investment in view of increasingly important goals. My mother Adriana Spazzoli was a strong advocate and promoter of this project and was personally involved in organising the team's activities". Besides being Mapei Group's former Marketing and Communication Director, Adriana Spazzoli was Vice-president of Sassuolo.

"My mother always maintained that you have to be responsible towards all the communities you are part of," Veronica Squinzi added, "paying great attention to young people. Sport is not pure entertainment or even pure and simple sport. It is a means of helping young people grow by giving them an important opportunity. Thanks

to sport, you can mature better and that is how the game should be. Our team shows that on a daily basis".

Simona Giorgetta also recalled that the Mapei Football Centre project had very clear goals right from the outset: the facility had to look great, be well-built, long-lasting, functional, simply designed and set neatly into its surrounding. An architectural design embodying Mapei's founding values. Last but not least, the theme of sustainability: Mapei Football Center has, in fact, been awarded LEED certification from GBC (Green Building Council) Italia for the use of state-of-the-art products and materials in terms of technology and sustainability.

The book

Corner Kick, published by Park Books that was founded in Zurich in 2012 and focuses on architecture and other similar sectors, will be on sale in specialist bookshops and from the publisher's website as of February 2023.



MAPEI WORLD NEWS

EVENTS,
SPONSORSHIPS
AND PROJECTS
BY THE GROUP'S
SUBSIDIARIES



USA - A NEW BUILDING MORTAR FOR 3D PRINTING

The first homes to be built by means of 3D printing in Virginia will be the result of a strategic partnership between Mapei Corp., a Group's U.S. subsidiary, the 3D printer supplier Black Buffalo 3D, and a construction company called Alquist 3D. With the help of a brand-new product called PLANITOP 3D developed in Mapei's Research & Development laboratories, Black Buffalo's labs and other external labs, it will be possible to build eco-sustainable homes for families in rural areas. With 3D printing, each layer of PLANITOP 3D cementitious mortar is gradually added to previously printed layers, so buildings can be constructed at lower costs in a short time and with less manpower required.



ITALY - GBC SPAIN AND GBC ITALY MEET AND WORK TOGETHER AT MAPEI HEADQUARTERS



Mapei SpA welcomed the winning designers in the 2019 edition of the "Premio Mapei a la Arquitectura Sostenible" to Milan on 27th October. Mapei Spain has been running this award since 2017 to promote sustainability in architectural projects focused on quality, innovation and respect for their setting. Also present were the President of Green Building Council España (GBCe), Bruno Sauer (in the photo, right), and the President of Green Building Council Italia, Marco Mari (left), who signed a memorandum of understanding in which GBCe and GBCi undertake to work together to promote research and sustainability to enhance historical and cultural heritage.

UAE - MAPEI EXPERTS AT THE MODERNSCAPES MENA SUMMIT 2022



Around 200 landscape architects, urban planners, consultants, representatives of city authorities and real-estate groups met in Dubai on 18th-19th October to discuss issues relating to the sustainability and efficiency of the cities of the future. Mapei Construction Chemicals, the Group's Emirates subsidiary, had two members of its Specification Team attend the event, Samantha Shepherd and Nisreen Salman (in the photo, on the right). They presented the company's products for urban open spaces and sports surfaces. These products included the MAPECOAT TNS range of resin coatings for sports fields and cycle paths, systems for urban areas and selected waterproofing agents.

GERMANY - NEW FACILITIES FOR THE SOPRO HEADQUARTERS

Five buildings designed by Onsitestudio are currently under construction in Mainz-Kastel, near Wiesbaden: they will house the new offices, Research & Development laboratories and training facilities of Sopro, a subsidiary of the Mapei Group. The new headquarters, which will occupy an area of 20,000 m², pays testimony to the company's desire to grow and was the focus of a ground-breaking ceremony (in the photo) on 2nd November. A mixing line, 14 silos and a monitoring system will also come into operation at the Sopro production plant in Amöneburg by late January 2023.



ECO ADHESIVES FOR QUALITY LIVING.



Mapei presents its one-component, silylated polymer-based adhesives, for perfect installation that guarantees a strong grip, quality and respect for the environment with every type of wooden flooring. **Ultrabond Eco S958 1K**, hard-elastic category - **Ultrabond Eco S Plus**, with no methanol emissions - **Ultrabond Eco S Lite**, lightweight adhesive with an extremely high yield.

EVERYTHING'S OK
WITH MAPEI

Learn more on mapei.com



QUESTIONS & ANSWERS

INSTALLING WOODEN FLOORS: PRODUCTS FOR QUALITY LIVING



by **Angelo Giangiulio**

Silylated polymer-based adhesives: the eco- sustainable choice

The idea of combining the benefits of polyurethane and silicone into one single product first came about at the beginning of the seventies.

Researchers started to study silane terminated prepolymers, the characteristics of which made them suitable for use in formulating sealants.

Over the years, the success of this technology led to the range of products for other applications also being extended.

Nowadays, apart from sealants, silane terminated prepolymers are also used to produce various types of adhesives for wood flooring.

Are there different types of silylated polymer-based adhesives?

Silylated adhesives are divided into three different categories, according to international standards EN 14293 and ISO 17178: Hard, Hard Elastic and Soft, which differ according to their hardness, elasticity, elongation (which can range between 0 and > 1) and bonding strength to concrete, which can vary between 2.5 and 1.5 N/mm².

How do you identify which is the right class to use?

The Soft category of adhesives is used to install all formats of pre-finished multi-layered and medium-format solid wood flooring. Hard Elastic adhesives are chosen for installing solid wood and pre-finished flooring in any format, while with the Hard category of adhesives there are no limitations to the type of wooden flooring they can be used for.

What does Mapei propose regarding silylated polymer-based adhesives?

The products on offer from Mapei cover all classes specified in the

standards. Mapei one-component, silylated polymer-based adhesives contain no water, solvents, amines or epoxy resin.

Mapei has also developed two cutting-edge adhesives: ULTRABOND ECO S LITE one-component adhesive, suitable for installing all types of pre-finished or pre-sanded multi-layered and medium-format solid wood flooring, and ULTRABOND ECO S PLUS one-component adhesive with no methanol emissions, suitable for installing all types of pre-finished or pre-sanded and medium-format solid wood flooring on any type of substrate, including heated screeds.

Which characteristics have made this type of products so highly appreciated?

Easy cleanability of the surface of pre-finished flooring, without a doubt, particularly flooring with an oil finish. No less important is the complete absence of hazard labels on the products, along with the fact that these adhesives are able to obtain environmental certification, such as Blauer Engel and EMICODE EC¹Plus. All the silylated adhesives from the ULTRABOND range have, in fact, very low emission of volatile organic compounds (VOC).



Find out more
ULTRABOND ECO S LITE

Corporate Product Manager,
Wooden Flooring Line



PRODUCTS IN THE SPOTLIGHT

PREPARING SUBSTRATES BEFORE INSTALLATION,
PROTECTING AND DECORATING WALLS,
SMOOTHING SILICONE SURFACES

1

Eco Prim T Easy/ T Pro /T Plus



THE PROPER START FOR ANY INSTALLATION WORK

ECO PRIM T is the multi-purpose line of acrylic primers for a proper preparation of substrates. It includes three primers with the lowest VOC emissions, ensuring super-rapid drying times and maximum ease of application. The primers can be applied on both floor and wall substrates and work as adhesion promoters, insulators between gypsum and cement, dust fixatives and absorption regulators. ECO PRIM T EASY is a primer for screeds and absorbent and gypsum-based substrates. ECO PRIM T PRO is a multi-purpose primer for absorbent screeds and substrates, gypsum-based substrates, ceramic and natural stone. ECO PRIM T PLUS is a universal primer for all absorbent and non-absorbent substrates.

2

Mapecoat ACT Satin



GUARANTEEING A HIGH LEVEL OF HYGIENE

Acrylic-based enamel paint for interiors with special biological protection agents with a broad spectrum of action, able to counteract the deposit and proliferation of moulds, viruses and bacteria on surfaces. It gives the surface a smooth and satin finish. It stands out for its excellent resistance to washing and a very low dirt pick-up. It is suitable for the protection and decoration of all environments, where it is necessary to guarantee a high level of hygiene and prolonged resistance to cleaning operations (healthcare environments, environments subject to HACCP protocol). It is stain-resistant, highly durable and, thanks to its very low level of VOC emissions, ensures excellent living comfort (Class A+).

3

Ultracare Smooth Silicone



CREATING SMOOTH, COMPACT SURFACES WITHOUT HOLLOW

It is a water-based smoothing product with an innovative formulation which can be applied on most of the surfaces commonly used in the building industry (ceramic tiles, stone, glass mosaic, etc.). It facilitates the finishing of the sealant after its application and contributes to create smooth, compact surfaces without hollows that could ease dirt pick up and lead to future formation of moulds. It is suitable for all types of sealants (acetic, neutral, polyurethane, etc.) and does not leave residues. When combined with specific sealants (such as MAPESIL AC or MAPESIL LM), the product enhances their mould resistance properties by guaranteeing a surface with no porosities.

Eco Prim T

EASY / PRO / PLUS

START WITH THE RIGHT CHOICE.



Any installation work gets a better start with **Eco Prim T**: the multi-purpose line of acrylic primers with the lowest VOC emission, perfect for any site. Super-rapid drying times, maximum ease of application and high performance for a practical, quick job, and always with respect for the health and the environment.



EVERYTHING'S OK
WITH MAPEI

Learn more on mapei.com



WAY TO GO AMBROGIO!



Ph © Vincent Olivaud

Ambrogio Beccaria with Alla Grande - Pirelli finished **second** in the Class40 category of the **Route du Rhum** after being part of the leading group for the entire race. A true **display of determination, tenacity and strategic ability** in the face of adversity, while **"never stopping pedalling"**!

Thanks for taking us with you, **Ambrogio**, on this incredible adventure across the mighty Atlantic Ocean.

Learn more on mapei.com

