

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 Manicastrì

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