



Dear reader,

The second issue of the "BREAKING NEWS RE-CON line" newsletter **focuses on the RE-CON AGG technology**. Our aim is to give you an insight into why and how the RE-CON AGG products were developed and how they can help customers to produce concrete with lower costs and reduced environmental impact. Use the contact details in the last page for feedbacks, subscriptions and requests of information.

Sven-Henrik Norman - Corporate Product Manager - RE-CON line

We will start with the background of the **global changes in the concrete market**. The high consumption of sand and aggregates, combined with an increased attention to the carbon footprint of concrete, has led to a situation where **alternatives to natural sand, cement and water need to be used**. This created the need for the RE-CON AGG technology.

We also include an interview with our colleagues from the R&D department in Milan in which they talk about **the latest developments in products from the RE-CON AGG range** and where they can be used to reduce cement consumption and increase sustainability in concrete production.

This technology is already in use at the production sites of some of Mapei's customers as you can read in the case-study featured in this issue: the **SS16 "Adriatic" trunk road in Central Italy**. We also enclose **an interview with Luca Iacucci, Concrete Technologies Specialist at Calcestruzzi SpA** (HeidelbergCement Group) focusing on the use of RE-CON AGG admixtures to obtain the right concrete mix for this big infrastructural project.

Finally in this issue, we will also tell you about **a brand-new product in the range: RE-CON PH 1000**. The admixture is used to **reduce the pH of water emitted during concrete production**, thus meeting an environmental issue that has become the focus of attention in the concrete industry.

**THIS ISSUE
FOCUSES ON**

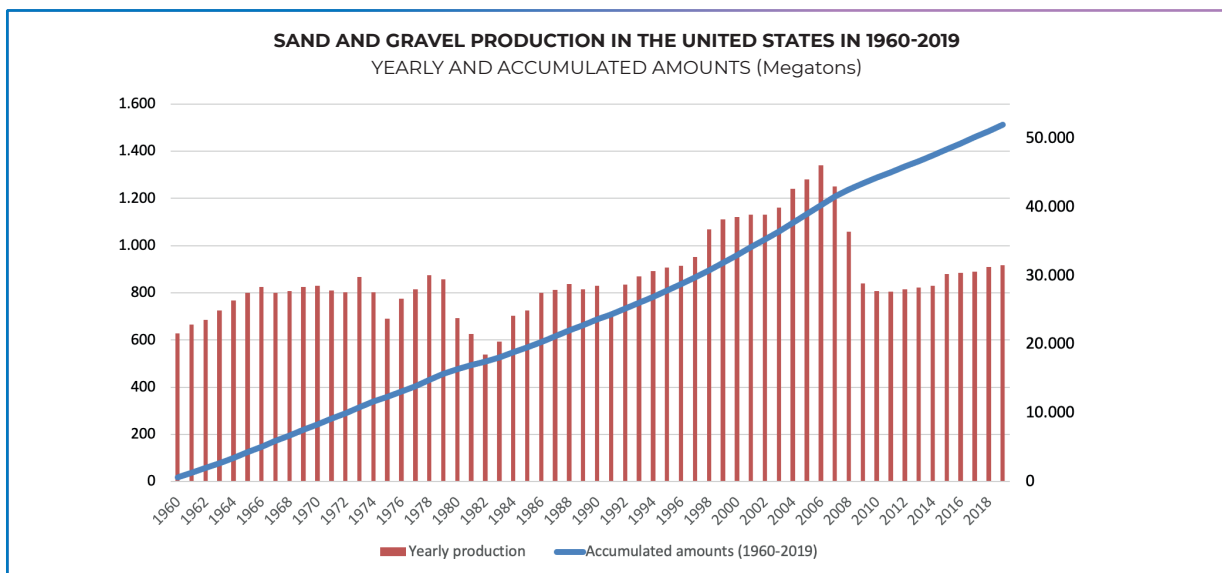
RE-CON AGG range



RE-CON AGG TECHNOLOGY MAKES IT CHEAPER AND EASIER TO USE SUSTAINABLE RAW MATERIALS IN CONCRETE



The intense construction activities we are seeing in areas all around the world has led to a **depletion of some of the materials we previously took for granted**. Among these materials are **natural sand and gravel**. According to the United States Geological Survey (USGS), 50 billion cubic tons of sand and gravel have been extracted since 1960.



The USGS also published a report back in 2011 called "[Aggregate Resource Availability in the Conterminous United States, Including Suggestions for Addressing Shortages, Quality, and Environmental Concerns](#)" by William H. Langer. In this report, **several geographical areas in the United States were identified as having a shortage of natural aggregates**: the Coastal Plain and Mississippi embayment, the Colorado Plateau and Wyoming Basin, the glaciated Midwest, the High Plains, and the non-glaciated Northern Plains. Since its publication in 2011, an average of 860 million tons have been extracted each year according to USGS statistics.



The shortage of natural aggregates and sand is also a global issue. The United Nations Environment Program (UNEP) published a report in April 2022 called "[Sand and Sustainability: 10 Strategic Recommendations to Avert a Crisis](#)". The report states that the **global use of sand has tripled in the last two decades to reach 50 billion tons being extracted globally each year**. This is enough to build a wall 27 m wide and 27 m high across planet earth. The report concludes that continued uncontrolled extraction of sand at the current rate is unsustainable for both social and environmental reasons.

This insatiable hunger for sand and gravel is putting **the construction and concrete industries under pressure to find local high quality raw materials**. The natural sources of sand and gravel are geological formations that are not always located within a short distance of where they are needed, so transport is becoming a growing cost and environmental challenge.

The market is increasingly **focusing on the environmental impact of concrete** as a building material. This has led to concrete producers starting to oversee their operations from a Life Cycle Analysis perspective in which the EPD (Environmental Product Declaration) states the Global Warming Potential of equivalent CO₂ (often stated over 100 years as GWP100) for a given concrete mix design, and this value is declared to the buyer. The biggest motivator to finding alternatives to remote natural resources is, perhaps, still the cost awareness caused by rising fuel costs for transport. However, this may change when **the cement industry implements environmental actions such as Carbon Capture and Portland Clinker replacement on a much larger scale**; the relative environmental impact of the sand and gravel in a concrete mix design can then be expected to be higher. After all, around 60-70% of the volume of concrete is made up of coarse and fine aggregates (Sand and Gravel).

WHAT ARE THE ALTERNATIVES TO NATURAL SAND AND GRAVEL AND WHAT EFFECT DO THEY HAVE ON CONCRETE?

Since **high-quality sand and aggregates are not always available** in the regions where they are most needed, **concrete producers may be forced to use sand containing impurities** (e.g. clays) or manufactured sand with higher fines content and increased voids content due to a less rounded and smoother particle shape.

The increasing shortage of natural sand and gravel is also a driver towards **utilizing more and more recycled concrete aggregates in new concrete** to increase the rate of circularity of material use. The European Commission issued the [Waste Framework Directive](#) in 2008 with the aim of reaching 70% recycling of construction and demolition waste by 2020. In 2018, the average re-use in the European Union was around 50%.



Reclaimed concrete aggregates can be a good alternative to exploiting natural resources. When the more porous structure may lead to increased water demand if used in very high dosages, RE-CON AGG liquid admixtures help mitigate this absorption.



The focus on lowering the carbon footprint of concrete means **secondary cementitious materials, such as fly-ash, slag or natural pozzolans, are being introduced** into more and more concrete mix designs in increasingly higher ratios.

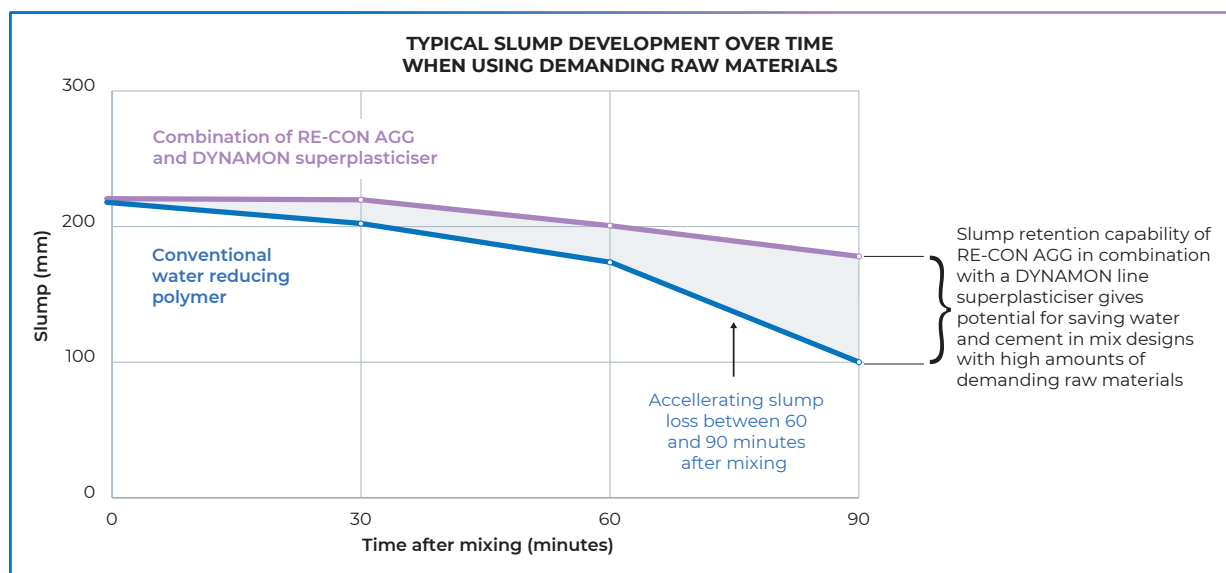
All these new materials (manufactured sand, recycled concrete, supplementary cementitious materials) now entering the concrete production sector have one thing in common: they are more “thirsty” than natural sand and gravel. By this we mean that, to achieve the same workability, **they consume much more water and admixtures** than natural aggregates and the pure Portland clinker cements used in the past.

Why is this a problem? There are two main factors involved: firstly, **it is very difficult for a concrete producer to be able to guarantee the flowability of concrete** delivered to a building site if the concrete absorbs high amounts of water and water reducing admixtures during transport from the mixing plant to the customer’s building site. This restricts the ratios in which these alternative materials can be used. Too high slump loss may lead to whole loads being discarded by the end user and reclaiming and waste cost is increased for the concrete producer. Secondly, if concrete producers add more water in the mix, **they need to add more cement to guarantee the same strength and durability** specified by the customer. More cement means the concrete will have both **a higher cost and a higher carbon footprint**.

RE-CON AGG technology helps mitigate slump loss through a unique combination of polymer technology (you can read more in the following pages of this newsletter).

In principle, by using RE-CON AGG in combination with a superplasticizer from the DYNAMON range, **the workability of fresh concrete (slump) can be maintained** for up to 90 minutes, even when using highly demanding concrete aggregates.

The benefit for the customer lies in **reduced production costs**, lower environmental impact of the concrete mix design, and higher quality and predictability of the properties of fresh concrete transported for 60 to 90 minutes to the customer without losing slump, as shown in the graph below.



To summarise, RE-CON AGG technology is **a big help towards achieving both important environmental goals and reducing the cost** of concrete production with more sustainable raw materials.



THE CREATION OF THE RE-CON AGG PRODUCT RANGE



The Research and Development of the RE-CON AGG Technology

by Paolo Fornoni, R&D Coordinator - Admixtures for Concrete Research & Development Laboratories

The first studies carried out in the Mapei Research & Development Laboratories into the compatibility of super-plasticising admixtures with aggregates containing clay date back to around ten years ago. Clay is a phyllosilicate mineral made up of hydrated layers of aluminosilicates. Depending on the configuration these layers mutually assume, clay can have from a low to highly “harmful” effect during the concrete mixing phase. In fact, **some types of clay have the capacity to trap large quantities of water** between one layer and another and, what is even more serious, **they are able to capture the polymers that form the basis of super-plasticising admixtures**. It only requires a very small amount of clay in the aggregate to drastically reduce the effectiveness of an admixture.

There are basically two ways of counteracting this phenomenon when formulating admixtures: to find “sacrificial” substances in order to deactivate the clay or to **identify polymers immune to the inter-layer absorption action exerted by the clay** and with the capacity to guarantee their dispersive action. Research carried out by the Mapei Laboratories analysed both methods, but the solution was found with the second.



LEFT. A piece of naturally occurring clay. Intrusions of clay may present in natural sand deposits all over the world. RIGHT. The RE-CON AGG admixtures were developed in Mapei Research & Development Laboratories after testing different methods and solutions.

STUDY OF SAND AND THE SEARCH FOR THE “RIGHT” POLYMER

Behind the success of this project there was an important study of the types of sand used by the leading concrete manufacturers in Italy and abroad. **The composition of the various types of sand was analysed thanks to special XRD and TGA techniques** to qualify and quantify the amount of clay contained in them. Apart from analysing their composition, standardised techniques were applied to **quantify the content of harmful clay using the methylene blue method**. It was important to be able to **construct a laboratory test sample in mortar**, adding a certain type of clay to the normalised sand to represent what would be the large-scale effect in concrete mixing plants.

Thanks to the collaboration with the Polymers Department of our R&D Lab, it was possible to evaluate numerous synthesised polymers for this scope. After numerous experiments **a polymer was identified with a structure that was only minimally affected by the absorption of the clay** or, as would seem to have been demonstrated in more recent studies, **with the capacity to shield the clay particle, inhibiting access to the rest of the polymers** inside the layers.



ARRIVAL OF THE RE-CON AGG ADMIXTURES

The first product of this type launched on the market, **RE-CON AGG 100**, was proposed as an admixture to be used in combination with other super-plasticising admixtures from the DYNAMON range. Its action, especially when added in the first phase of the mix, shields the clay and promotes the action of the super-plasticising admixture added afterwards. The combined action of the two admixtures **creates concrete with the same characteristics as a formulate without clay**, but with excellent workability of the fresh mix. Because the market also required an “all-in-one” product, two more products were developed: **RE-CON AGG 200 (for summer use)** and **RE-CON AGG 400 (for winter use)**.

These products perform both a **mitigating action on the clay** and a **super-plasticising action**. Apart from being highly effective in concrete containing clay, products from the RE-CON AGG range **mitigate the effect of recycled aggregates**, which are becoming more and more widely used in the concrete industry to partially replace virgin aggregates.



RE-CON AGG admixtures can be used to obtain high quality concrete mixes even if they are formulated by using low quality sands.

NEW PRODUCT COMING SOON: RE-CON PH 1000

Increased focus has been put on enforcing environmental laws and regulations of the process and on washing water emitted from the production of concrete. Many concrete mixing plants are located in urban areas and the **leakage of water with a high pH**, and that may contain **excessive levels of heavy metal contaminants such as hexavalent chrome** from cement, **is an environmental problem** that needs to be addressed.

Mapei's RE-CON line is already helping in this respect because RE-CON ZERO and RE-CON DRY WASHING will greatly reduce the concentrations of solids and high pH cementitious residue in washing water at the mixing plant. However, there will always be a certain amount of high pH water that needs to be emitted from the plant, which is why Mapei's Nordic R&D team has developed an easy-to-use pH regulating liquid product called RE-CON PH 1000. In the coming issue we will talk more in detail about this product.





RE-CON AGG FOR THE SS16 “ADRIATIC” TRUNK ROAD

RE-CON AGG used in the concrete mixes for a trunk road in Central Italy

In the summer of 2021 work started to widen the stretch of the SS16 “Adriatic” trunk road between Falconara and Torrette di Ancona in the Central-eastern part of Italy. The work was commissioned by Anas (the company that manages Italy’s trunk road and motorway network) with **an investment of 250 million Euros and will result in the doubling in the width of the road to four lanes** along a 7.2 km long stretch between the junction with the SS76 trunk road at Falconara and the Torrette exit.

Work should take around 3 years and includes the construction of a new carriageway alongside the existing one (which will also be upgraded to match the characteristics of the new carriageway), the construction of new tunnels and viaducts, upgrading of the existing tunnels, replacement of the road deck of one of the existing viaducts and the demolition of four viaducts.

Mapei has already taken part in the work with **the supply of 63,500 litres of RE-CON AGG 200 admixture**, which was used during the first few months only **to mitigate the effects of the high content of silt and clay fines in the sand**, which would have had a negative influence on the strength and workability of the concrete mixes used.

RE-CON AGG 200 is a modified acrylic polymer-based admixture in water solution and has the capacity to disperse cement granules very efficiently and control the hydration process of the cement. It **may be used in combination with clayey sand or other aggregates with high absorption to reduce the total amount of water** employed and to achieve high mechanical properties at the hardened state.

The admixture was added to the two concrete mixes from Calcestruzzi SpA (part of the HeidelbergCement Group) used in the project. Each mix was of class S4 with a workability time of 90 minutes, but with different compressive strength classes (Rck 40 and Rck 30), and use of the admixture will certainly be extended throughout the duration of the work to complete the new road.



LUCA IACUCCI, CALCESTRUZZI SPA

A concrete specialist working for one of our biggest Italian customers tells us about the advantages of using RE-CON AGG 200 to enhance the concrete performances

What were the main challenges with this project regarding the formulation of the two concrete mixes?

The main challenges were to maintain workability for 90 minutes and to achieve the specified mechanical properties using not exactly the best quality sand.

Which raw materials were used? And what, in particular, led to the use of clayey sand?

The following raw materials were used:

- 0-4 sand
- 6-12 gravel
- 12-20 gravel
- CEM IV/A-V 42.5 SR cement from Ravenna (central Italy)
- **RE-CON AGG 200** admixture

We had to use clayey sand because it was so difficult to source better raw materials locally.

What part did Mapei admixtures play in the formulation of the mixes?

RE-CON AGG 200 enabled us to **significantly reduce the amount of mixing water** to achieve the mechanical properties required and to maintain their workability class for 90 minutes without any particular problems.

RE-CON AGG 200 also enabled us to **limit the development of air in the mixes**, something that tends to happen with admixtures from our competitors.

