Interview by Peter Edwards, Global Cement Magazine

BIOCIDES FOR ADMIXTURES

LANXESS' Heidi Twaddle Carr looks at how biocides help concrete admixture performance.

***Global Cement (GC):* Please could you introduce LANXESS to our readers?**

Heidi Twaddle Carr (HTC): LANXESS is a German specialty chemical producer that was spun out of Bayer AG during a restructuring in 2004. It is divided into three main segments: Consumer Protection, Specialty Additives, and Advanced Intermediates. I work in the Consumer Protection segment in Material Protection Products. This covers biocides for a wide range of building materials, including concrete admixtures. Over the past 20 years, LANXESS has grown via a number of acquisitions to become one of the top three biocides companies worldwide.

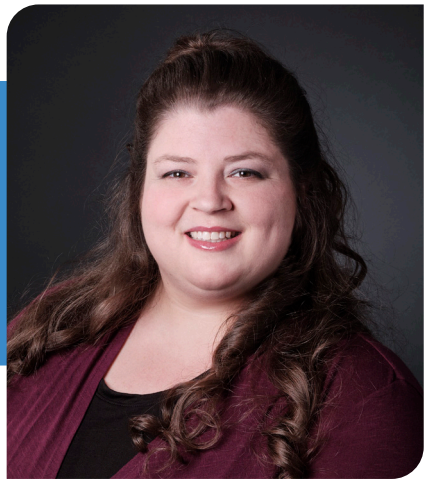
Today, LANXESS produces biocides at more than a dozen plants in the US, Germany, France, China, India, the UK, Singapore and Brazil. Some only supply regional customers, while others supply globally.

***GC:* How do biocides function?**

HTC: There are various modes of action. The most common include lysing the cell, basically ripping a hole in its membrane so it 'explodes.' They can also act similarly to antibiotics, another type of antimicrobial. For example, penicillin works by fitting into the bacterial cell wall. When the cell attempts to divide into two, it reaches the penicillin molecule,

LANXESS provides biocides to a wide range of industries, including concrete admixtures.

Heidi Twaddle Carr is the Technical Applications Manager for the construction sector at Lanxess, a Germany-based producer of specialty chemicals, including concrete admixtures. Twaddle Carr has worked for the company since 2004, when it was spun out of Bayer's Chemical and Polymer business.



the division process is disrupted and the cell dies. Biocides can also disrupt the action of mitochondria or prevent DNA from replicating.

It is important to remember that, whether they are acting against algae, fungi, mould, yeast or bacteria, biocides are not active against humans, animals or plants. The microbial cells targeted are completely different. Of course, those using them must still take appropriate precautions, as they are potentially hazardous in other ways.

***GC:* How specific can biocides be?**

HTC: Overall, biocides are not very specific against a particular strain of microbe and most fit into one of two classes. The first are broad spectrum biocides that work against a wide range of moulds, bacteria and yeasts. These are used in concrete admixtures, which are most commonly liquids and hence prone to microbe growth. On top of this, they are often rich with starchy carbohydrates that are like an 'all inclusive buffet' for microbes. The job of the biocide is to stop microbes from propagating in the admixture, as microbial growth can prevent the finished product from functioning as intended during production and/or use.

Secondly, there are biocides that act against specific forms of microbe. Some applications might need just a fungicide, bactericide or algicide. Wallboard liner, for example, which is used in the gypsum wallboard sector, is not a liquid. It is, however, prone to mould, so we would use a fungicide to combat that.

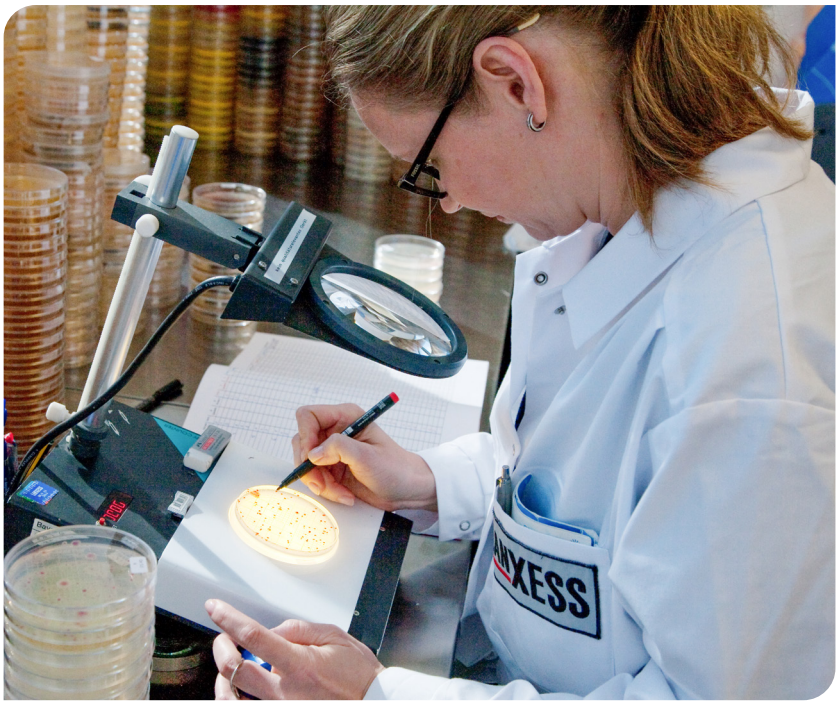
***GC:* What doses are required?**

HTC: Biocides are used in low doses, typically less than 1% (10,000ppm) of a finished concrete admixture, sometimes as low as 0.05% (500ppm). That's in the admixture formulation. In the concrete itself, the amount of biocide will be very small indeed. Despite the low dosages, biocides are highly regulated by relevant regulatory bodies around the world, and they are regulated for each application. This means that it is not possible to use one for another application if it is only registered for use in concrete admixtures.

***GC:* What other factors need to be considered when using biocides?**

HTC: There can be big issues with interactions

Even a small dose of biocide can have a massive effect on microbial growth.



Lanxess is constantly conducting research into new biocides.

between biocides and raw materials, other additives and certain process conditions. For example, high temperatures will deactivate particular biocides and others cannot be used at high pH. Some biocides interact with amines, others react with oxidising and reducing agents. The unhelpful effects of this - in addition to high microbe growth and loss of effectiveness - can include viscosity changes and colour changes, adversely affecting a range of applications. To help, Lanxess has technical managers for each application. They help clients to circumnavigate the potential pitfalls.

***GC:* What are Lanxess' main biocides for the global concrete sector?**

HTC: It is not really possible to say that there is a 'favourite' biocide favoured by concrete producers globally. Lanxess supplies more than 100 different biocidal products, which are used in different markets, according to relevant local regulations. Users are mainly interested in the function of the concrete admixture itself and, as long as the biocide works, they are happy.

***GC:* What is Lanxess doing to reduce its CO_2 emissions?**

HTC: Lanxess is doing a lot on the sustainability front and, since its founding in 2004, has already halved its absolute CO_2 emissions. We are now targeting an 80% reduction by 2030 and to achieve climate-neutrality by 2040. This involves responsible sourcing and changing production processes. After that, we will focus on achieving net-zero emissions in all parts of the supply chain.

***GC:* How are concrete producers' demands on Lanxess' additives and biocides changing at the moment?**

HTC: While there is some innovation in this area, for example a higher than ever focus on sustainability, most of the changes on the biocides side come from the evolving regulations in different markets and regions. If a particular country changes which biocides are permitted, it is up to Lanxess and its clients to respond. This also affects anyone exporting concrete (often pre-cast elements) from one country to another. Exporters must ensure that the biocide is permitted - for that application - by both relevant authorities. It can be a bit of a headache, and it's not something that is necessarily at the forefront of a producer's mind. To help, Lanxess has regulatory groups in all major markets that keep its clients in touch with changing regulations in individual countries.

***GC:* How are low CO_2 concrete mixtures affecting Lanxess' biocides and the products themselves?**

HTC: We see that it is often additives that allow for concrete blends to achieve lower CO_2 emissions. This will mean that the market will demand more additives - and hence more biocides. New additives may also require new protection plans and new biocides altogether.

Indeed, Lanxess is constantly researching new biocides, but this is costly and time-consuming, due to the difficulty of obtaining approval. Even once you've developed a product it can still take many years for it to gain approval and become market-ready. I would say that biocide development is a few steps down from the pharmaceutical industry in that regard. It can be a frustrating process.

Due to the complexity of this process, we are also looking at synergies that arise from using certain combinations of existing biocides. It may be possible to reduce overall doses in this way and/or gain better efficacy.

To facilitate and 'expedite' our efforts, we introduced the use of AI technologies to 'virtually screen' large assays that used to be carried out manually, vastly reducing the amount of time taken and lowering the cost. Once narrowed down, we can confirm relevant 'leads' in the laboratory. Digitalisation and AI is also helping to optimise blends and production processes, which reduces our CO_2 emissions too.

***GC:* Thank you for your insights today Heidi.**

HTC: You are very welcome indeed.