A lifetime advancing cement science and innovation

After 35 years at VDZ, including more than 25 years as chief executive, Dr Martin Schneider will retire in November 2026. During his tenure, he transformed VDZ into a thriving international research and technical services organisation and helped establish the European Cement Research Academy (ECRA), whose collaborative research laid the foundations for the oxyfuel technology which has recently been demonstrated at the Catch4Climate plant at Mergelstetten. ICR met Dr Schneider in Düsseldorf to discuss his career, the development of carbon capture technology, the potential of mechanochemically-activated clays and the cement industry's route to net zero.

■ *by **Thomas Armstrong**, ICR, UK*

ICR: You trained as a laser physicist. How did you find your way into the cement industry?
Dr Martin Schneider (MS): Indeed, I am a laser physicist by profession. It was purely by accident that I saw this job description in the newspaper. I went to the interview, but I thought they were not going to select me because I had no idea of cement or concrete.

I really liked the job from my very first day. I started in the environmental department. It had to do with emissions, environmental impact, permit procedures, public hearings and permit applications. I grew into this and that was fascinating for me.

ICR: What did your early environmental work involve?
MS: The two major projects were the new kiln in Lägerdorf and the new kiln in Rüdersdorf. They were more or less built at the same time and the kilns had a similar size, at a little more than 5000 or 6000tpd. The cement companies asked me to guide them through the environmental impact assessments.

We provided a lot of consulting work on emissions, kiln behaviour and air pollution control devices, but also on atmospheric dispersion modelling, noise and impact measurements around the plants.

I liked participating in the public hearings and hearing the perspective of those who did not understand the projects, and who had fears and concerns. It was not always possible to convince people, but with many you were able to build trust. I liked being between industry on the one hand and the public on the other, trying to moderate and identify solutions.

ICR: You subsequently moved from environmental affairs into cement chemistry. How important was that step?
MS: I shifted to become head of the cement chemistry department. It was a new field for me technically and I still remember one holiday learning cement chemistry on paper cards: there was a question on one side and the answer on the other.

That also helped me in the environmental debate because, for example when you talk about CO_2 and the question of how to abate it, it has to do with clinker and cement chemistry covering aspects of the product and of SCMs.

All of a sudden, I was also in the political arena. We had the first voluntary commitment on CO_2 reduction that we gave as a German industry and as cement producers. It was nowhere near today's roadmap, but it considered what trajectory we could aim for in our specific CO_2 emissions per tonne of product and what requirements we would need.

During his tenure as CEO of VDZ, Dr Martin Schneider transformed the organisation and helped established ECRA

ICR: You became VDZ's chief executive in 2000. What was your vision for the organisation?
MS: I had a deep respect for such a prestigious and renowned institution, dating back to 1877. At the same time it was clear to me that VDZ, as a purely national association fully funded by German members, would have to prepare for the future. The industry was in a huge phase of becoming more international with the cement companies thinking more global. I felt that VDZ had to adapt to this.

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I had the vision of VDZ as an association, but at the same time also a research institution and a company, providing services. I felt that these were the three pillars which, once they were established, would be like a table with three legs: very stable.

That has really materialised. Today it is there and it works. All three pillars benefit from each other.

ICR: How has VDZ's research retained its relevance to cement producers?
MS: The research was always – and still is – pre-competitive. As an association, you can only work on topics which are outside the competitive brackets. Our research was all seen in the context of the industry moving ahead and providing something that was not known at that time – and we were able to develop knowledge in our sector which I think is unique.

ICR: Why did you initiate the European Cement Research Academy?
MS: At that time, I felt that we could bring our knowledge and ideas into a broader scale beyond Germany. I talked to companies and CEOs in the broader European context about building a research platform that would go beyond a single organisation such as VDZ.

That was in 2003, when the European Cement Research Academy (ECRA) was first conceptualised. We first started with seminars and workshops. Then it became clear that there was room for something bigger. We said: let us focus on one or two research topics which are really special for our industry. That was the willingness of ECRA to drive innovation in our industry.

ICR: Carbon capture became one of ECRA's most important research areas.

Ground-breaking work by VDZ and ECRA on oxyfuel technology led to the carbon capture plant at Mergelstetten, Germany
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How did that programme begin?
MS: At that time, carbon capture was completely new. Some thought had been given to it in the power sector as a way to reduce CO_2 emissions completely, but it was not clear whether it could be applied to the cement kiln.

Today, the VDZ is not only an industry organisation but also a research institution and a service provider
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We knew about oxyfuel enrichment, and we scanned the literature and found some thoughts here and there. All of a sudden, we had a project. The industry put money together for the first steps and we started with a literature study.

The industry contributed financially, but it also contributed knowledge and perhaps emotion: the willingness to build something bigger and to move the industry ahead.

We built up competence through universities, equipment suppliers and producers. And as VDZ we were proud to contribute to this. There were work packages covering the cooler, refractories, sealing and other parts of the process. We had PhD and Master's students working on these subjects.

ICR: How did this research culminate in the Catch4Climate oxyfuel project at Mergelstetten?
MS: In 2017 we thought that we could now build an oxyfuel pilot kiln. We had four sites in Europe which would have qualified at that time, but we did not have the money.

The Innovation Fund was going to be set up, but it was not available at that time. We realised that ECRA, with around 40 members but no equity, could not run a project like this. Four different members said: "We will do this. We will not wait for funding. We will split the cost and invest." They then had an internal process, with objective criteria, to decide which site would qualify.

Together with the equipment supplier, the four producers further developed the kiln. That was exactly what we wanted as ECRA: to open the room for really good solutions in our industry.

The result was the first oxyfuel kiln and its opening ceremony last week.

ICR: How mature is carbon capture technology today?
MS: Looking at the full value chain of carbon capture and storage, it is clear that all the elements are basically there, although when it comes to the details many technical questions still need to be addressed to scale up carbon capture. What is still ahead of us is putting all the puzzle pieces together and making sure that they link nicely.

What we are lacking, from a technical point of view, is a connecting CO_2 infrastructure and easy access to storage. It is not enough to have a couple of storage sites in one part of Europe. We need to look at this on a much bigger scale. We also need a financial de-risking of the infrastructure once it is started to be built. That cannot be carried out by a single company or a single industry.

ICR: Can carbon capture become a viable global solution?
MS: We have to make sure that, in the long term, carbon capture is affordable. I do not mean affordable only for a few cement plants close to a storage site, or only for Europe or parts of North America where there is easy access. We have to make sure that there is a long-term solution globally.

Therefore we must further develop the technology. On the capture side, how can we bring down the cost and make it more energy efficient?

In some countries, the markets do not have the capability to pay for this, for very good reasons. It is not a question of willingness; it is a question of affordability. We also need solutions for the global industry.

ICR: At the moment in Europe, we have around 20 carbon capture projects preparing for FID. What policy framework is required to move the European projects forward?
MS: The EU ETS was the driving force for the transformation measures that we are now anticipating. I am not talking only about carbon capture. Carbon capture is at the very end. There is still quite a bit that needs to be done before getting to the capture point, but that has to be carried out in parallel. You cannot do it one after another because then it will be too late.

Carbon capture is not the one-size-fits-all solution. It is the ultimate solution for everything that cannot be achieved by conventional measures, which we must drive beyond today's expectations.

At the same time, we need a clear political commitment that the main target will be maintained. In an industry where heavy investment is ahead of us, you cannot change the strategy from one year to another and flip back and forth.

We need a sufficiently high CO_2 price to make the business case, otherwise the whole thing will not fly. And this of course requires a level playing field allowing the first movers to invest.

We also need infrastructure and affordable access to storage sites, not somewhere 3000km away from the plant. Therefore, we also need onshore solutions – such as underground formations in depleted oil and gas fields – otherwise the majority of the plants will not have an easy access to storage sites.

The framework conditions are developing too slowly, but I am still optimistic. They will come.

ICR: Is the current EU ETS timetable and 2040 end date realistic?
MS: The 2040 date was not selected as a date explicitly; but the EU ETS exactly defines the availability of certificates, and you can count to the tonne of CO_2 when this availability is going to be zero. With the current linear reduction factor this happens to be in 2040. If there are no longer certificates available then companies will not have a licence to operate. One of the discussions in the revision of the ETS is to synchronise the availability of certificates with the EU's general climate target of 2050, which I think is necessary to gain more time for the industry to invest and the infrastructure and storage sites to be developed.

ICR: How should CBAM protect European producers during the transition from lower-cost importers, and ensure importers pay a fair carbon tax?
MS: The industry needs a level playing field. And in the context of rising carbon cost, plants importing into the ETS area must have the same rules to comply with. This is what CBAM aims for. And it really must work, otherwise the decarbonisation of the European cement sector will fail.

ICR: Beyond capture, where do you see the greatest potential for reducing emissions?
MS: Lowering the clinker factor is the easiest way to reduce CO_2 because you cover the process and fuel parts at the same time.

With all the work going on with regards to SCMs, and the strong focus that the whole industry has on this, we will see some very interesting SCMs in the time to come. I mean not only the material itself, but also how it is produced and the degree to which it can substitute clinker. There is going to be a game changer.

Clays are very interesting because, if you calcine them, they provide pozzolanic activity. Together with limestone, they are excellent SCMs which can support each other in terms of CO_2 emissions and – in terms of concrete – workability, strength and reactivity.

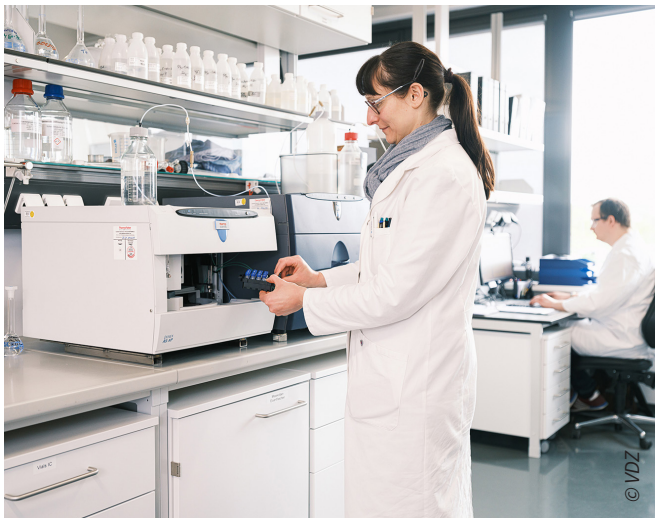
But we also have recycled concrete fines and perhaps by-products from other sectors. All these SCMs, including of course clays, are particularly interesting. This is also the case because mechanochemical activation seems to offer new ways to produce these SCMs which will be something very important for our industry.

ICR: Why do you regard mechanochemical activation as potentially transformative?
MS: Mechanochemical activation is a measure to activate materials. It has been known about for a long time, but ways we can scale it up in our industry and build the machinery are new.

It will completely change our understanding of the reactivity of materials. With clays, it is not only the clay minerals that are activated, as in thermal activation. The quartz, for example, is also mechanochemically activated. Materials which today we would not consider to have sufficient quality to be an SCM could qualify. That is what the first results show when comparing different clay qualities that have been mechanochemically or thermally activated.

There is a huge benefit from thermal activation, but there is an additional

VDZ has been able to develop knowledge in the cement sector that is unique and supports the industry in moving forward



benefit from mechanochemical activation. The question is: how we can scale this up further, not only at a single site but across the industry?

I am very optimistic. We need a deeper scientific understanding of what is happening at the surface of the particle and how we can utilise this for other materials. ECRA, by the way, is working at it.

ICR: Does the process require too much energy to qualify as a viable low-carbon solution?

MS: It is activation; not pure grinding. You could consider the reactor to be a mill, and it reduces the particle size, but most importantly, it activates the material.

Activation means that you bring the material thermodynamically to a higher energy state. You need this for the subsequent hydration reaction to take place. Otherwise, it would stay dead. Therefore, it is not only grinding energy that you provide. You also provide chemical energy through mechanical energy. You basically convert mechanical energy into chemical energy.

We need to understand where we will finally be in terms of kilowatt-hours per tonne of product. There is work and research to be undertaken, with a focus on scalability.

But the energy needed for this activation is electrical energy. There are no direct CO_2 emissions from this process. With green electricity, we can completely decarbonise the production process, while producing something that performs very well as an SCM and substitutes clinker. For me, it will be a game changer in how we look at SCMs in our industry.

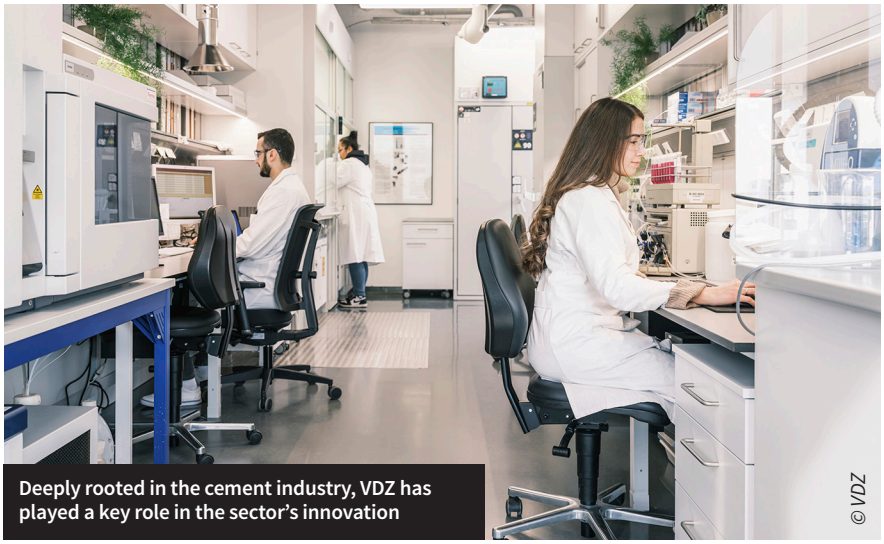
ICR: What will the cement plant of the future look like?

MS: Clinker will still be the key element of tomorrow's cement in that timeframe. I am not sure what it will be in 100 years, but for many decades Portland cement clinker will still be the main constituent of cement.

We will have efficient kilns producing Portland cement clinker. We will have an environment in which we produce highly-reactive, affordable and decarbonised SCMs, including through mechanochemical activation.

At the same time, we need something for the CO_2. In the medium term, it will be capture for storage, with all the machinery that we need.

The cement plant of the future will have a coexistence of the high-temperature part and the low-temperature part. The low-temperature part is where we deal with the CO_2. It is a completely new world for us, and we have to combine the best knowledge of both worlds.



Deeply rooted in the cement industry, VDZ has played a key role in the sector's innovation

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In the longer term, there will also be solutions for CO_2 utilisation, although there is still the question of the energy efficiency of converting CO_2 into something else. CO_2 is a very stable molecule, otherwise it would not be the end product of combustion, so making something useful from it takes a lot of energy and therefore we need efficient processes. In the medium term, the main focus will be on storage, with utilisation coming later.

ICR: What values have guided your leadership of VDZ?

MS: An organisation like VDZ is not so different from a person. You need a good sense of togetherness, a good sense of pride, a good understanding and acceptance of rules, and the ability to deal with a complex world. Then you understand that you are part of something bigger.

We understand VDZ as a family, with a strong sense of togetherness. We are proud of ourselves and our industry and try to take the stage for our industry whenever we are called onto it.

Our rules have to do with mutual respect. We provide an atmosphere where people can develop ideas, be innovative, earn money and understand what a customer and a member are.

We also commit ourselves to moving our industry towards sustainability. We feel connected to the global cement industry as something bigger than a single company. Cement is a good binder: it binds us all together.

ICR: Looking back, what achievement gives you the greatest pride?

MS: To leave an organisation which is really working, which has clear values and which is economically on safe ground. We have a new building, we have a future and we are still deeply rooted in our industry.

We are not an organisation for a purpose that has nothing to do with our industry. We are an integral part of the industry. I am proud that this was possible to maintain and even to further develop.

I am also proud of the innovative thoughts that we were able to plant in our industry and how the world looks at VDZ.

ICR: Are you optimistic about the cement industry's future?

MS: The industry has a bright future. We need cement and we need concrete because this is the basis of a civilised society. Imagine what the world would look like without cement and concrete?

You can use it anywhere around the world, based on the original raw materials. Limestone and clay are found everywhere, generally speaking. It is also affordable. There is no other binder which can substitute this material to that degree.

Many technical challenges in our industry have been solved, and today we have a product which is really affordable. The clinker-burning process is highly energy efficient and perfectly optimised. Now we have the CO_2 emissions on our agenda, and we have to find a solution for them.

If you look back into the history of our industry, we always felt that the challenges at each time were the biggest ones. But there are always still more to come, and I think we will overcome these challenges as well. And at a given time we will have a carbon-neutral industry. I am very sure. ■