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SGS INTRON

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Developments around the main ingredients of cement

ProRail looks to innovation partnerships to improve sustainability

Monitoring reinforced geopolymer concrete – initial results are positive

50 YEARS SGS INTRON

SAFER
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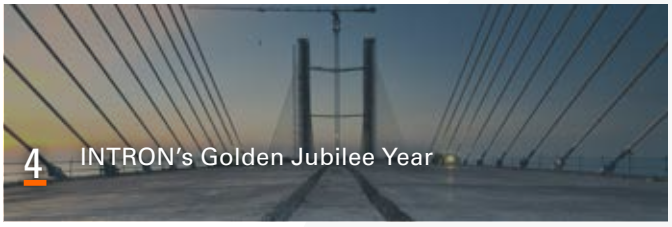
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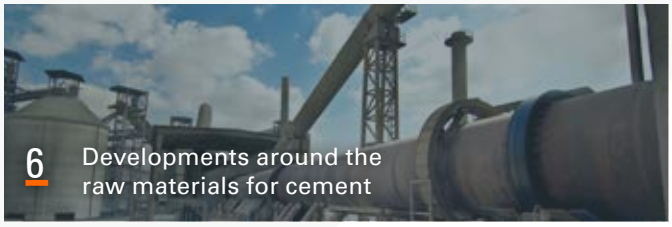
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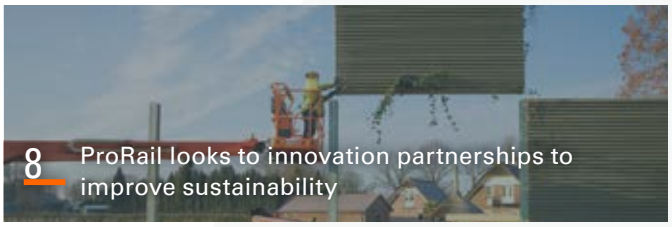
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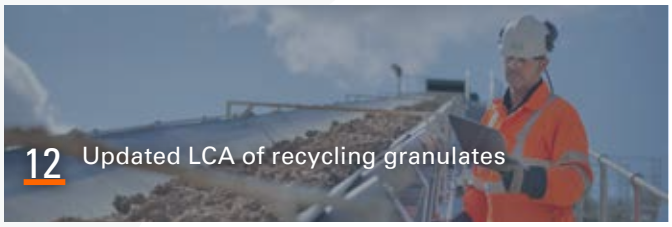
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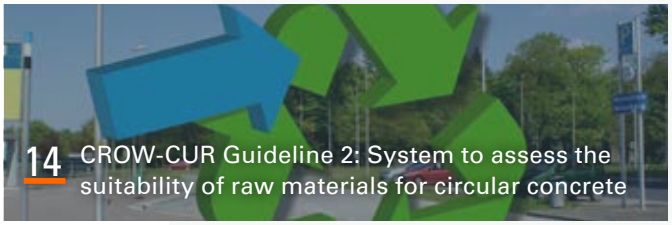
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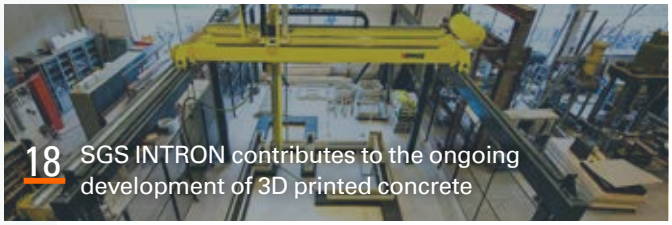
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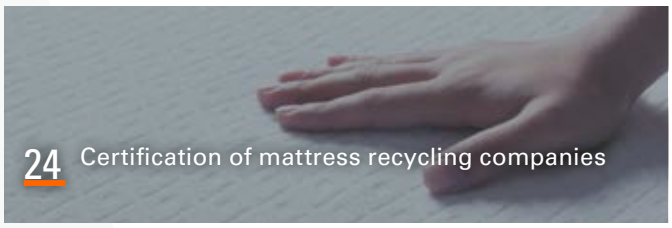
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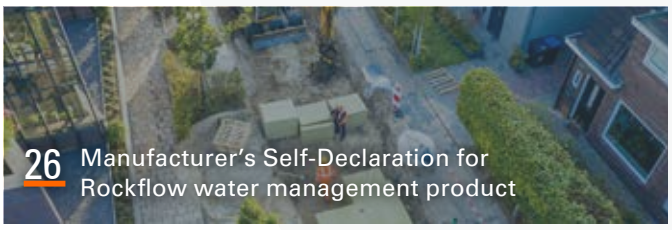
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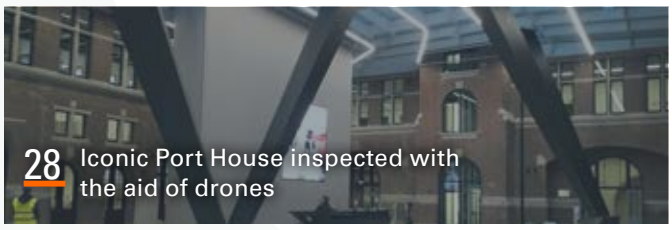
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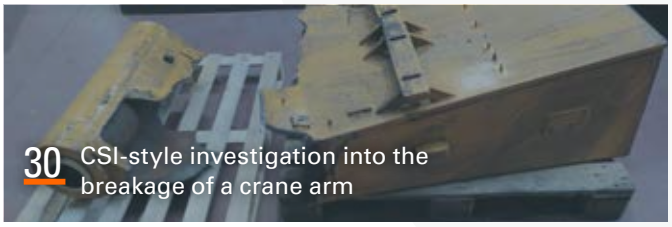
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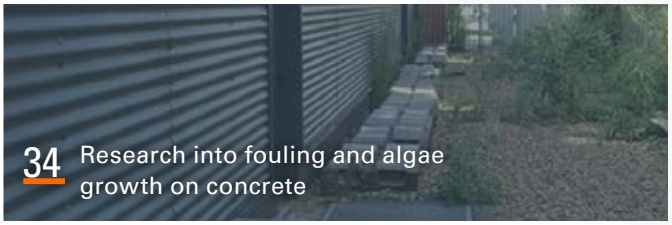
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50 years of working for an ‘engineerable’ world

Is the world as ‘engineerable’ as we think? The arrival of coronavirus, but also the rapid advance of climate change, force us to confront the fact that we must reckon with events we did not see coming. Yet ‘engineerability’ is about the most important thing in construction and industry. If something cannot be engineered, you shouldn’t even be starting it. Yet I don’t think that is entirely true. What do I mean by that? Engineerability has many facets, but in our business, quality is the most important aspect. To define quality, here at SGS INTRON we consider whether something is ‘fit for purpose’. In other words, a material, building product or structure has to meet the defined functional requirements. And I can tell you: that’s not always easy.

It actually starts with the process of defining requirements. Who does it? In whose interest? And how? It makes quite a difference whether a manufacturer imposes requirements on its own product or the government does. Thankfully, these requirements are often drafted by groups of stakeholders known as ‘Committees of Experts’. They are a representative, expert reflection of the market. We often take part in this process as a certifying body or as advisers. Everyone has their own role. Our goal is not so much to establish the requirements themselves, but rather to assess whether they are verifiable as such. And that is no easy task. It makes a difference whether one is dealing with known materials or processes, or whether they are new and innovative. Has the market already experienced it or will it be seeing it for the first time?

In the fast-changing world of 2021, where the agendas around resources, energy and climate are dominated by the need to transition to a circular economy, it is easy to forget that things must remain engineerable. This starts with defining the right requirements. But we must also accept the importance of continued learning, especially when it comes to innovations. We shouldn’t jump to conclusions or point the finger of blame, but rather we must keep talking to each other and looking forward. Then we can adapt the requirements when we have more knowledge.

This year marks SGS INTRON’s 50th anniversary. For 50 years we have established, improved and predicted the quality of building materials and processes. We have helped to develop an engineerable construction sector and are very proud of what we have achieved in the process. With a mix of seasoned veterans and new talents, we remain committed to the further improvement and engineerability of construction and industry. Our work is never done.

RON LEPPERS
DIRECTOR SGS INTRON

INTRON's Golden Jubilee Year

SGS INTRON is celebrating its 50th anniversary. It is a golden milestone that we will not let pass us by. We are proud to have occupied a position within the construction industry for the last fifty years, putting our knowledge and expertise in the field of building materials and construction processes to good use. It is not given to many companies to celebrate such a lifespan.

50 YEARS SGS INTRON

Perhaps you remember us in our early days during the 1970s, when we were pioneers. Or were you around when we established our certification arm in 1988 and received STERLAB accreditation in 1990? You may know that we were part of the Tauw Group for a while from 1995, but for a time we were known as BDA-INTRON and were in at the founding of BouwQ. In short, we look back on a rich history. Since 2010 we have continued to write that history as part of SGS: a world leader in the field of testing, inspection and certification. And what we have always been good at, understanding building materials and construction processes, is still our foundation.

It is with pride and humility that we celebrate our anniversary this year. We have already achieved a lot, but the current challenges are diverse, topical and very urgent. Together with you, we will continue where we left off to create a sustainable future.

Download our white paper on the basic principles of CE marking for construction products

For more information contact: Peter Crucq peter.crucq@sgs.com

The process of obtaining application of the CE mark on construction products is not simple. SGS receives diverse inquiries from the market and regularly explains the necessary processes. To complement these services, we have recently prepared a white paper on the basic principles of CE marking for construction products. In this way we hope to provide better support to our customers.

All construction products within the European Economic Area must comply with the European Construction Products Regulation. This regulation says that all products marketed or sold in Europe must be CE marked if the product in question is covered by a harmonized standard. In this white paper we describe the whole process of mandatory and voluntary CE marking and the new developments being considered.

It also covers:

- The essential nature of CE marking as a product passport within Europe and the responsibilities involved
- The possibility of applying voluntary CE marking where no harmonized standard applies
- The basis for assessing whether a product meets the requirements for CE marking
- Clear explanations of the various terms, including ITT, FPC, EAD, ETA, TAB
- Current and future developments, including the UKCA and the revision of the Construction Products Regulation

Download the white paper free of charge at
www.sgs.com/cemarkconstructionproducts

Developments around the raw materials for cement

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The Dutch Directorate-General for Public Works and Water Management (Rijkswaterstaat) has asked SGS INTRON to prepare a summary report on developments concerning the raw materials used as principal components in clinker-based cement and alkali-activated materials. The aim of this report is to provide an insight into the availability of clinker substitute materials and raw materials for cement on the Dutch market over the next ten years. This is important in light of the goal of reducing CO_2 emissions by at least 30%, as laid down in the Dutch Concrete Agreement.

CEMENT CONSUMPTION IN THE NETHERLANDS

Cement consumption in the Netherlands averages roughly 5 million tonnes per year, made up as follows: 55-60% CEM III, 30-35% CEM I and the remaining 5-10% CEM II and CEM V combined. The average clinker content of cement used in the Netherlands is low: an estimated 50%. Because the Netherlands no longer produces Portland cement clinker itself, it must be imported, thereby increasing CO_2 emissions due to transport by around 3%.

PULVERIZED COAL FLY ASH

The availability of pulverized coal fly ash on the Dutch market is under pressure due to the already implemented and planned closures of coal-fired power plants in the Netherlands and in many other EU countries. It will likely be supplemented to some extent by imports, probably from countries far outside the EU. This will increase CO_2 emissions of CEM II/B-V by around 10% compared to the CEM II/B-V previously produced with Dutch pulverized coal fly ash and Portland cement clinker.

GRANULATED BLAST FURNACE SLAG

The future of the EU steel industry is far from certain at the moment, as efforts to protect the sector are at odds with the high CO_2 emissions that do not meet climate targets. The production of blast furnace slag in the Netherlands would be assured if less environmentally damaging technologies, such as hydrogen reduction, were implemented. However, the quantity and quality of granulated blast furnace slag produced using these new technologies are not yet known. In all likelihood, the

Netherlands will have to continue to import increased quantities of granulated blast furnace slag. In the case of imports from Turkey, this will increase CO_2 emissions of CEM III/A by around 9% and of CEM III/B by around 13%, including the increased contribution from imported Portland cement clinker.

NEW CEMENTS

New alternative cements are increasingly coming to the fore – mainly belite-calcium sulfoaluminate-ternesite cement, carbonation-cured cement, and limestone-calcined clay cement, as these could potentially be used before 2030. Belite-calcium sulfoaluminate-ternesite can reduce CO_2 emissions by 30% compared to CEM I. It is currently marketed by Heidelberg Cement as 'Ternocem' and by Lafarge as 'Aether'.

Carbonation-cured cement can have 60% lower CO_2 emissions compared to CEM I. Two different approaches to carbonation-cured cement are marketed by the companies Solidia and CarbonCure. Both companies supply both precast and ready-mix options.

Limestone-calcined clay cement (LC3) allows for a high level of Portland cement clinker replacement. LC3-50 consists of 50% clinker, 30% calcined clay, 15% limestone and 5% gypsum. LC3-50 enables a 30% reduction in CO_2 emissions compared to CEM I.

ALKALI-ACTIVATED BINDERS

Worldwide use of alkali-activated binders remains extremely small and limited to niche applications. Large-scale use is hampered by lack of regulation and higher costs, among other things.

The aluminosilicate source usually consists of granulated blast furnace slag, pulverized coal fly ash or metakaolin. The future availability of granulated blast furnace slag and pulverized coal fly ash is uncertain, and most of it is currently used in blended cements. Metakaolin requires larger amounts of sodium silicate as an activator, making it a less ideal source of aluminosilicate.

Solutions of sodium hydroxide combined with sodium silicate, or sometimes silica fume, are used as activators. Little sodium silicate is produced worldwide. Both sodium silicate and silica fume have limited availability and are also very expensive. Sodium hydroxide is also an important activator. If cement were to be replaced with alkali-activated binders, global demand would be many times greater than the current annual production of sodium hydroxide. Based on current production and surpluses of sodium hydroxide, only 7% of the concrete produced worldwide based on Portland cement clinker can be replaced by concrete based on alkali-activated binders. However, alkali-activated binders have significant CO_2 emission reduction potential. Alternative raw materials with low CO_2 emissions as sources of aluminosilicate should be explored. Furthermore, standards should be established for the use of alkali-activated binders.

ALTERNATIVE APPROACHES AT RAW MATERIAL LEVEL

As well as alternative cements, 'supplementary cementitious materials' (SCMs), including the powder fraction released by innovative recycling methods, can play an important role in achieving the objectives of the Dutch Concrete Agreement.

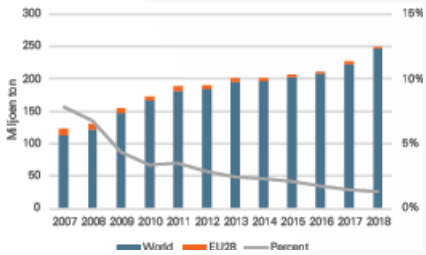
More efficient use of materials can also make a significant contribution. The cement content of concrete can be reduced by optimizing the mix through improved grain packing and/or by using suitable admixtures and mineral fillers. Material consumption can also be reduced through more suitable applications of high-strength concrete.

Cements should be defined not only by their composition, but rather should be classified by performance characteristics such as stability, durability and circularity This will allow the use of binders that are not based on a minimum content of Portland cement clinker. For this reason, greater importance should be attached to Dutch CUR Recommendation 48 – Procedures, criteria and test methods for assessing the suitability of new cements for use in concrete and for the equivalent performance of concrete with fillers.

FINALLY

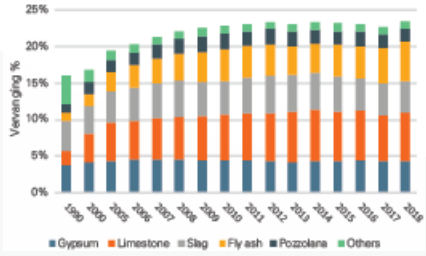
Dutch cement has the lowest CO_2 profile in the world due to the use of cement with a low clinker content (e.g. CEM III/B). It is therefore unlikely that the CO_2 emissions – and hence the ECI (Environmental Cost Indicator) – of Dutch binders for concrete will decrease significantly in the coming years. Greater transport distances of raw materials that keep the CO_2 profile of Dutch cement so low (granulated blast furnace slag and pulverized coal fly ash) will have a negative impact in this respect.

To keep the CO_2 profile low or reduce it further, more incentives are needed to use alternative materials (especially residual materials with negligible CO_2 emissions). The availability and/or use of new cements and binders with low CO_2 emissions must also be encouraged.



Pulverized coal fly ash used in the production of blended cement or as a substitute for cement, worldwide and in the EU [million tonnes] and percentage of pulverized coal fly ash used in the EU compared to its use worldwide [%]

Granulated blast furnace slag used in the production of blended cement or as a substitute for cement, worldwide and in the EU [million tonnes] and percentage of granulated blast furnace slag used in the EU compared to its use worldwide [%]



SCMs used worldwide for the production of clinker-based Portland cement

ProRail looks to innovation partnerships to improve sustainability

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Making sure the trains run on time today – that is where much of ProRail's work is focused. The Innovation department is somewhat detached from this operational responsibility, therefore it has the space to work on innovative projects focused on the future. "We are pursuing the targets defined in the Paris Climate Agreement," explains sustainability policy advisor Eva Dijkema. "That means being climate-neutral by 2050. We are aiming for maximum circularity by 2030. The 'Rijkswaterstaat' – the Dutch Directorate-General for Public Works and Water Management – plans to become climate-neutral by 2030 as well, though we think that's a tall order. But anything we can do to speed things up, by hitching a ride with our 'big brother' and sustainability partner Rijkswaterstaat, we will of course seize with both hands."

EVA DIJKEMA

OPPORTUNITIES TO TRY OUT GENUINELY DIFFERENT MATERIALS

How can you make really big (systemic) leaps when it comes to reducing carbon footprint or achieving circularity? First, by starting with the top five most impactful materials and systems within ProRail, such as railway sleepers. Also by keeping innovation pathways focused on finding sustainable alternatives outside the regular system. This is because ProRail's requirements for existing products often do not fit with, or are not a good fit for, wholly new and innovative products. "Hence, we choose separate innovation pathways," says Eva Dijkema. "Also, we have to put these kinds of processes out to tender. There are several innovative ways of inviting tenders. A pilot project is one of them, and an innovation partnership is another. Two years ago, we set up a pilot for railway sleepers. SGS INTRON was already involved in this as our sustainability partner.

Experience with sustainable railway sleepers has taught me that it is better to work jointly on new developments – to look at things together and work out what is the best solution to this problem. Hence, we now look for innovation partnerships. This is also because participation is possible from a very low TRL (Technical Readiness Level) – even if all you have is a good innovative idea, for example. With a pilot, a product must largely meet our requirements already. Innovation partnerships give us the opportunity to try out genuinely new and different materials. That is what we want."

START SMALL

Two innovation partnerships were launched at the end of last year: one for sustainable retaining walls and one for noise barriers. The retaining walls which ProRail now uses under platforms are concrete. "We use a lot of concrete around the track," says Eva Dijkema. "This was an obvious area to work on: it's a material with a large carbon footprint." ProRail started small by using innovative types of concrete in paving stones. "Now we are working on the next step: use in light structural elements, such as retaining walls. That's a bit more exciting than a paving stone but not as exciting as, say, a bridge." ProRail also plans to collaborate on the development of sustainable noise barriers: "Those are also in the top five most impactful materials and we're going to be building a lot of them in the next few years."

SUSTAINABILITY PARTNER SGS INTRON

SGS INTRON is helping ProRail to get an insight into the sustainability of various innovative products, such as retaining walls and noise barriers. "We determine whether the sustainability calculations provided by the innovation partners make sense," explains senior consultant Ulbert Hofstra from SGS INTRON. "ProRail includes sustainability in every project through the Environmental Cost Indicator (EQI,

a single score that summarizes all environmental impacts, based on a Life Cycle Assessment or LCA)."

Innovation partners must also demonstrate with the EQI and circularity calculations that their product or material delivers environmental benefits. But for highly innovative products, this can be quite difficult. Ulbert Hofstra says: "The products are often so different that even the tools we normally use are frequently inappropriate."

TRADITIONAL TOOLS ARE NOT SUFFICIENT

For example, the circularity index does not take into account the use of bio-based materials. So how do you weigh those in the calculations? "It is really great how SGS INTRON addresses this type of situation," Eva Dijkema thinks. "Of course we want to make sustainability as quantitative and as measurable as possible. But tests that are relevant to concrete are not at all relevant to other materials. We aim to give our innovation partners clarity in terms of precisely what we are looking for, but also leave space for things we don't expect, which don't fit into current systems. So I really appreciate the fact that Ulbert also looks closely at the quality of each innovation. We really need his expertise. That's because, especially in the case of the noise barriers, we are dealing with materials that are totally new to us, and sometimes quite surprising, such as blocks pressed from material dredged from ditches, also bio-based materials such as wood and bamboo. After talking to Ulbert, we decided to count these as secondary materials in the circularity index."

ADJUSTED REQUIREMENTS

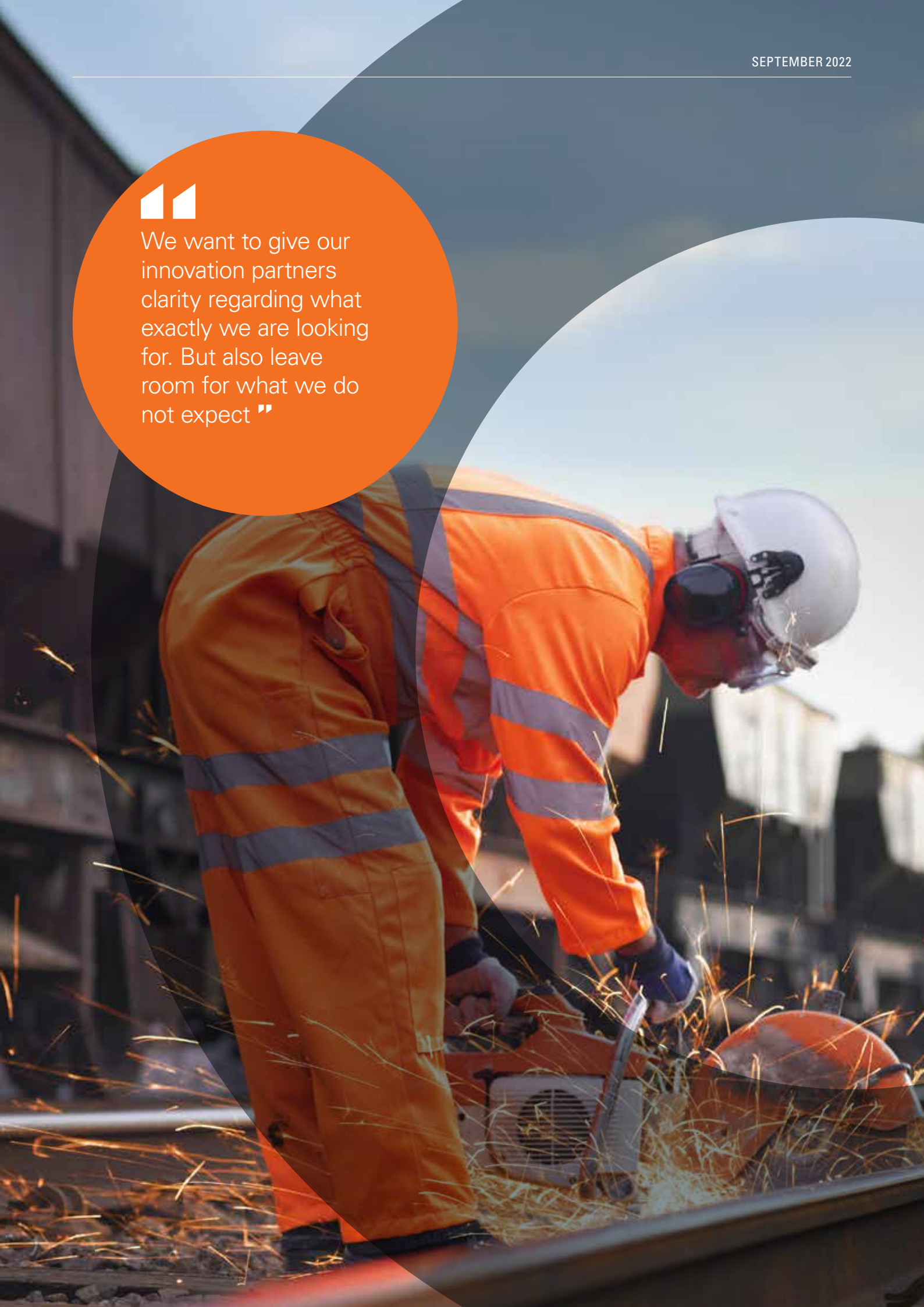
The innovation partnership on noise barriers is the largest. Out of approximately twenty applications, twelve participants were eventually given the opportunity to develop their idea into a business case and formulate research questions. "In this first phase, we don't ask everyone to do a full LCA calculation," says Eva Dijkema. "That's because we already know that some participants will drop out. Ulbert helps us thinks about what to look for, so that we can estimate the impact that certain innovations could potentially have, because naturally we want the most impactful innovations to go ahead. In the end, eight will get the chance to actually create a prototype of their product."

HUGE VARIATION IN PRODUCTS AND MATURITY

Eva Dijkema is enthusiastic about the innovation partnerships. "There are companies with plenty of experience in supplying products for the railway, who have no problem with our requirements. But there are also totally new companies that have never produced anything before. The challenge for us is to ensure that these companies also understand what we expect from them and why we define certain requirements. In addition to sustainability, safety is of course very important. Noise barriers are also subject to acoustic requirements and requirements relating to maintenance: they must be maintenance-free. But what if a noise barrier is very effective and sustainable, but requires a little more maintenance? The innovation partnerships also challenge us to examine our own requirements and adjust them where necessary. Fortunately, the systems specialist responsible for defining the requirements for noise barriers has a very open mind. He wants to make the system future-proof so that innovations can also meet the stipulated requirements."

"IT HELPS US TO GO AHEAD AND DO IT"

However, when it comes to embracing sustainable innovations, Dijkema sees her biggest challenge as getting the organization on board. "ProRail is a risk-averse organization," she explains. "Punctuality, availability and safety come before anything else. The average project manager or contractor currently working for ProRail is not going to work with very innovative products, because that carries risks when it comes to implementation. We need to do far more to reward innovation in tenders." Dijkema also expects the innovation partnerships to persuade people who are still skeptical or hesitant to go ahead. "There are materials where I have been thinking for some time: I reckon it's viable, why aren't we using it yet? The innovation partnership can help make sure that we go ahead and do it. The innovation partners go through different phases with their products, which we support: from the initial research phase, through laboratory-scale testing, the creation and testing of a prototype (away from the track), to actual construction along the track. Then you can show that it is viable, that there are good, sustainable alternatives to the materials we are accustomed to using. That will lead to them actually being used in our projects."



> We want to give our innovation partners clarity regarding what exactly we are looking for. But also leave room for what we do not expect "

Updated LCA of recycling granulates

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At the request of BRBS Recycling, the Dutch Branch association for Recycling, Breaking and Sorting, SGS INTRON has updated its LCA for recycling granulates. The LCA was conducted in accordance with the 'Determination Method to Assess the Environmental Performance of Buildings' of the Dutch National Environmental Database (NMD) Foundation. In addition to the old category 1 parameters, this method also features the new category 2 parameters from the most recent version of the European standard, which made an update necessary in any case. The LCA includes several new aspects which we aim to explain here. In particular, this concerns system boundaries, leaching and carbonation.

SYSTEM BOUNDARIES

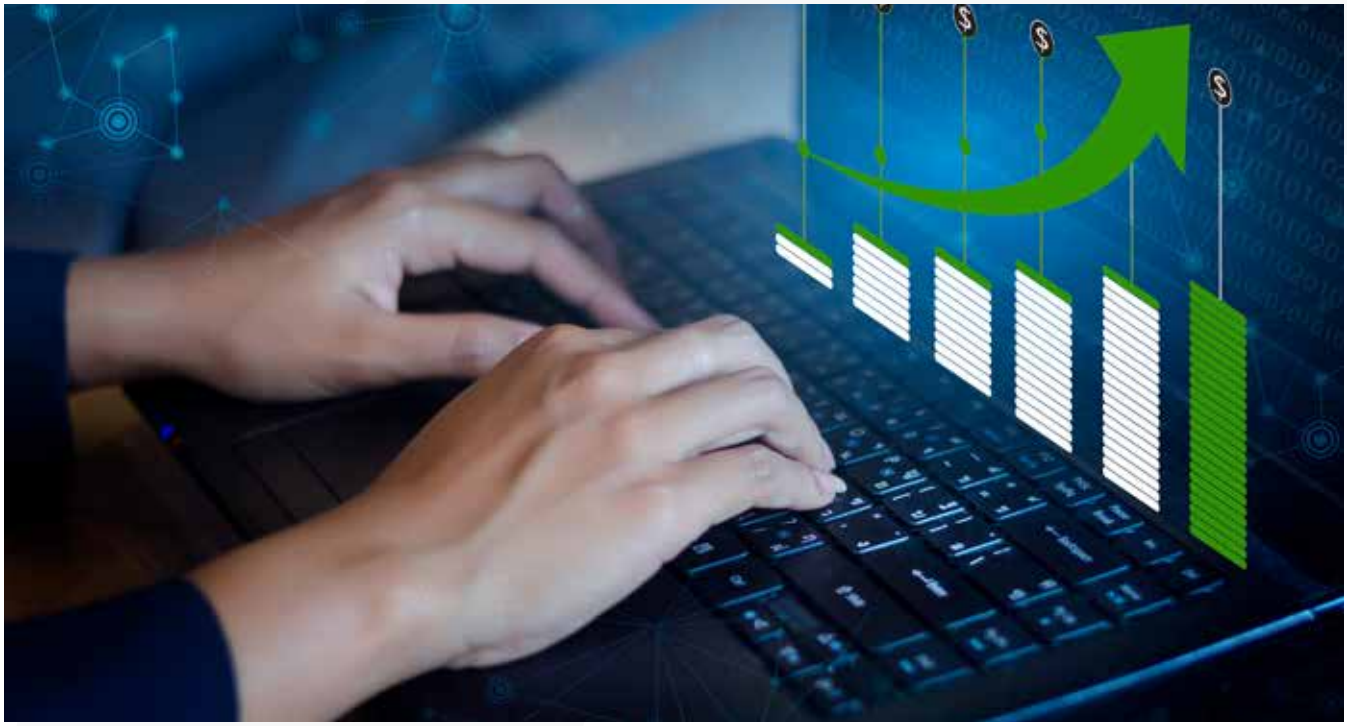
EN 15804+A2:2019, on which the NMD's Determination Method is based, states that the system boundary is at the end-of-waste point of the previous process. This means that, as long as concrete rubble is still waste, all environmental impact is allocated to the previous process, i.e. the concrete. Hence, the crushing process itself is not allocated to the concrete granulate which results from it, but is assigned to the concrete, which goes into it. The end-of-waste status of recycling granulate was established in the Netherlands in 2015 by a Ministerial Regulation.

Up to that point, no environmental impact was allocated to recycling granulate. Economic allocation was applied in the past. This meant that the dividing line was drawn about halfway through the crushing process, at the change from a negative to a positive value.

So now the allocation of environmental impact starts only after the crushing process. This means that only reprocessing operations carried out after recycling granulate has been produced are allocated to this material. These are, for example, washing of concrete granulate for use as aggregate in concrete and internal transport from the depot.

For the semi-finished products of concrete granulate used in concrete and asphalt granulate used in asphalt, only the production processes after the end-of-waste point are included, and not the further processes of the life cycle, such as the use phase and the end-of-life phase.

For mixed granulate and hydraulic mixed granulate used in foundation layers, these processes of the use phase and end-of-life phase are indeed allocated. These are not semi-finished products, but final products. The entire life cycle of these products must be accounted for.



LEACHING

Until now, leaching in the use phase of construction products was often neglected. This cannot continue. For example, the PCR for asphalt (a PCR [Product Category Rules] is a document with further LCA rules for a specific product) explicitly states that the leaching of asphalt in the use phase must be included. This has now been done for recycling granulate as well. BRBS Recycling has updated its database for its members to include leaching data. BRBS Recycling made this data available to SGS INTRON for inclusion in the LCA. SGS INTRON averaged the leaching data for each product category and converted it to the immission into the soil over 100 years for a 30 cm thick foundation layer. This conversion was taken from the former Building Materials Decree (Bouwstoffenbesluit). It appears that barium in particular contributes to the environmental impact of leaching. Because the overall environmental impact of recycling granulate in foundation layers is very low, the relative contribution of leaching is still significant.

CARBONATION

The LCA also examined the effect of potential carbonation on CO_2 emissions and the Environmental Cost Indicator of mixed granulate for foundation layers. The calculation is based on 25% residual hydraulic capacity in the granulate and assumptions as to the average clinker content of the cement present in recycling granulate. This effect is also limited, but again significant due to the low environmental impact of recycling granulates. CO_2 uptake in the use phase was finally calculated to be 3.5 kg CO_2 per tonne of mixed granulate. It would be beneficial to conduct experimental research into this.

The LCA is currently subject to mandatory third-party review, after which BRBS Recycling will make the data available to the NMD for inclusion in the national environmental database. In this way, the LCA data of BRBS members will become available for environmental calculations in civil engineering tenders and for producers of finished products (concrete and asphalt).

CROW-CUR Guideline 2: System to assess the suitability of raw materials for circular concrete

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CIRCULAR CONCRETE POLICY

The Netherlands has set a target of becoming a circular economy by 2050. For concrete, the target is even more ambitious: the Dutch Concrete Agreement states that all concrete waste streams will be recycled to a high standard by as early as 2030. A high standard means reused as raw material in new concrete or reused in concrete products, elements or construction. Therefore, it is important that we use raw materials now that do not hinder the circularity of that concrete.

REGULATION

There are no regulations yet on how to assess the circularity of concrete or the influence of the raw materials used therein. The Dutch CROW working group on "2nd/3rd life reuse in concrete" has therefore drafted a Guideline indicating how raw materials should be assessed as to their suitability for circular concrete by means of laboratory tests. Suitability for circular concrete means that the recycling products produced at the end of the life of concrete containing these raw materials are suitable for making into new concrete.

The drafted Guideline concerns the concrete raw materials: binder, filler and aggregate. No distinction is made between primary and secondary materials. The following fall outside the scope of this Guideline: additives (this concerns low dosages and will therefore have little or no effect) and, for the time being, fibers (because concrete granulates with fibers can be problematic in a 2nd life application).

METHODOLOGY

When concrete rubble is recycled, coarse concrete granulate, fine concrete granulate and, with some innovative techniques, a powder fraction are produced. These new raw materials produced from old concrete must be fit for use in new concrete. The raw materials used in the old concrete (1st life) must not present an obstacle. According to the Guideline, this can be demonstrated by laboratory testing.

This laboratory testing involves making (1st life) concrete with the raw material to be evaluated. Samples are then made from this that undergo material and environmental assessment. Based on these test results, a statement is then made about the suitability of the raw material in question for circular (2nd/3rd life) concrete.

The chart in Figure 1 shows the process for the material and environmental assessment of (fine and coarse) concrete granulate and powder fraction with the raw material, produced on a laboratory scale.

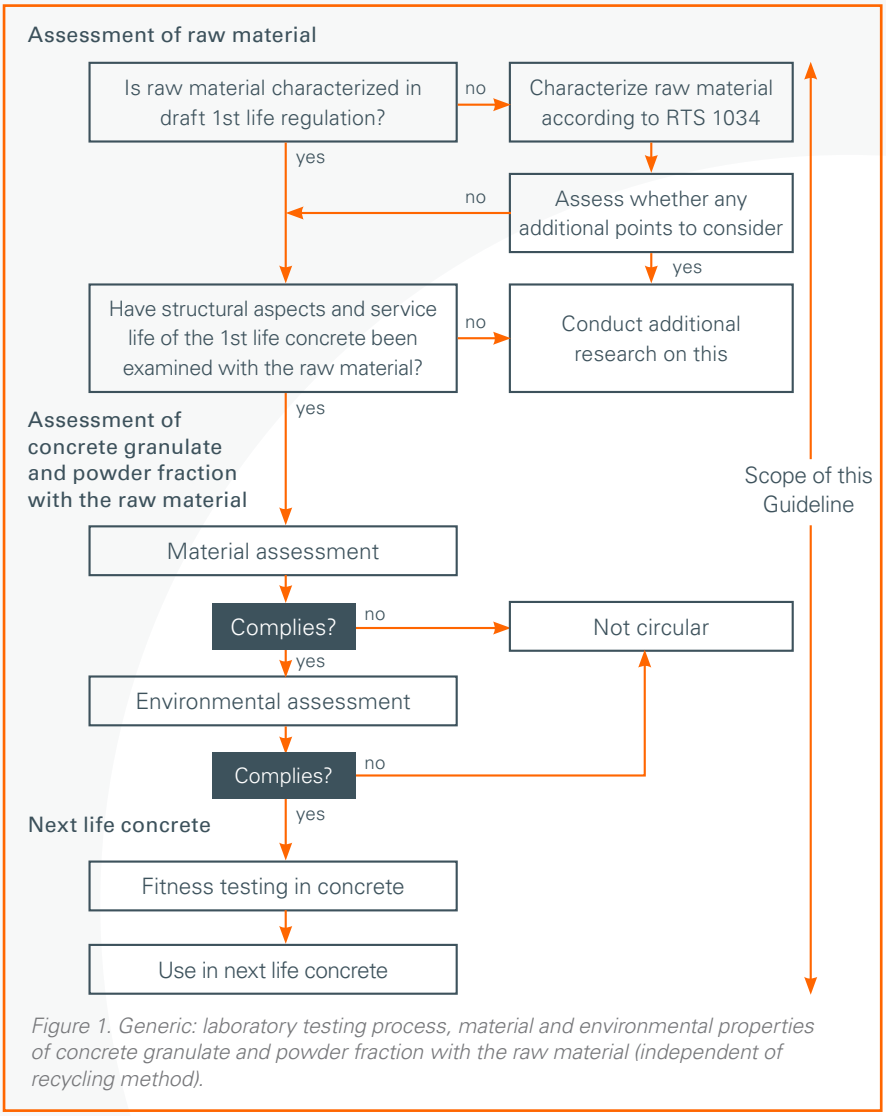

Figure 1. Generic: laboratory testing process, material and environmental properties of concrete granulate and powder fraction with the raw material (independent of recycling method).

MATERIAL ASSESSMENT

The current quality of concrete granulate from gravel concrete produced by traditional recycling methods is used as the lower limit for the assessment. The concrete chain has ample experience with this lower limit and the frameworks are laid down in the Dutch concrete standards and related documents, including NEN 8005, CUR Recommendation 112 and BRL 2506.

For the powder fraction, the current quality released by innovative recycling methods has been taken as a lower limit for assessment, and the general requirements in BRL 1804 (Fillers for concrete and mortar) are used as assessment criteria. It is not yet known whether powder fractions of the current quality are suitable for all concrete qualities and applications. This needs to be investigated further.

The laboratory tests are aimed at investigating the primary properties (Tables 1 and 2) of concrete granulate and powder fraction with the raw material to be assessed in relation to circularity, and are therefore not comprehensive as regards specific use in the 2nd life concrete.

The powder fraction is only tested for potential reuse as a filler in concrete. Other uses of the powder fraction, for example as a raw material for clinker, fall outside the scope of this Guideline.

Table 1. Properties to be tested, assessment methods and test criteria for laboratory testing of the material aspects of concrete granulate with the aggregate to be evaluated as raw material

PROPERTY	UNIT	ASSESSMENT METHOD	TEST CRITERION	
			Coarse fraction	Fine fraction
Water absorption	%V/V1)	NEN-EN 1097-6	≤16[2])	≤18[3])
Density (ρ_{rd})	kg/m^3	NEN-EN 1097-6	≥2,200[4])	≥2,200
Crushing resistance	-	NEN-EN 1097-2	≤40	No requirement
Chloride (acid-soluble)	%m/m	NEN-EN 1744-5	≤0.1	≤0.1
Alkali content (Na^2O-eq)	%m/m	CUR Recommendation 89	≤0.4	≤0.4

1. in volume-%, to be corrected in case of original aggregates with higher particle densities
2. corresponds to 7%m/m at particle density of 2,300 kg/m3
3. corresponds to 8%m/m at particle density of 2,300 kg/m3
4. inventory shows that concrete granulate almost always meets this requirement, the class is 2,000 kg/m3 for mixed granulate

Table 2. Generic properties, assessment methods and test criteria for powder fraction with the raw material

PROPERTY	UNIT	ASSESSMENT METHOD	TEST CRITERION
Alkali content (Na2O equivalent)	%m/m	NEN-EN 196-2	≤ 5.0
Methylene blue adsorption	%m/m	NEN-EN 933-9	≤ 1.2
Chloride content	%m/m	NEN-EN 196-2	≤ 0.2
Sulfate content (SO3)1)	%m/m	NEN-EN 196-2	≤ 4.0
Soluble phosphate content	%m/m	Appendix C of NEN-EN 450-1	≤0,01
Effect on strength 2)	%	NEN-EN 196-1	≥ 65
Effect on setting time*	min.	NEN-EN 196-3	< 120
Soundness	mm	NEN-EN 196-3	< 10

1. Sulfate content is always SO_3 in chemical analyses such as the analysis of NEN-EN 196-2
2. Requirement applies to mixtures of 25% (m/m) filler and 75% (m/m) CEM I 42.5 compared to test specimens made with 100% CEM I 42.5.

ENVIRONMENTAL ASSESSMENT

According to the Dutch Soil Quality Decree (Besluit Bodemkwaliteit), a raw material for concrete does not have to comply with the requirements, but the concrete containing the raw material does. A raw material that does not meet the Soil Quality Decree could produce concrete that does meet the Soil Quality Decree and vice versa. Therefore, it is better to assess the end-product. Demonstrating compliance with the Soil Quality Decree is usually done by certification under an NL-BSB® product certificate according to BRL 9338 (Concrete mortars and other cementitious mortars), BRL 9348 (Cementitious mortars from mobile volumetric dosing and mixing installations) or BRL 5070 (Precast concrete products).

Since currently over 90% of the concrete granulate is still used as unbound granulate, as foundation material, the 'freely usable' requirement from the Soil Quality Decree applies to the concrete granulate (see Table 3). For the purposes of this Guideline, the 'freely usable' requirement from the Soil Quality Decree applies to coarse and fine concrete granulate with the raw material to be assessed.

In addition to the requirements of the Soil Quality Decree, requirements are also defined for the presence of substances of very high concern (SVHC) and radioactivity. These are also properties that can hinder the circularity of the concrete. They are in fact already included in the assessment for the 1st life of a new raw material.

The SVHC aspect is still under development in legislation and regulations. In this Guideline the basic principle is that the raw material itself and concrete containing the raw material must not contain any SVHCs:

- above the limit of 0.1% or 0.01% m/m (REACH regulations, candidate list and restriction list)
- above the regulatory limit specifically defined for this raw material, e.g. for persistent organic pollutants (POPs)

However, there can never be more SVHCs in the concrete than there is in the raw material itself. Consequently, SVHC testing can be limited to laboratory testing of the raw material itself.

Radioactive substances are a specific category of SVHC substances. Where the raw material is used in concrete, concrete with the maximum replacement value of the raw material may not show an activity concentration higher than 1.0 Bq/g.

Based on the Decree on Basic Safety Standards for Radiation Protection (Besluit Basisveiligheidsnormen Stralingsbescherming), a reference level has been defined for gamma radiation indoors (in addition to external exposure outdoors) of 1 mSv/yr. This means that the activity concentration of the concrete containing the raw material (adding up the activity concentration of all constituents per m3 concrete) must not exceed 1.0 Bq/g.

This SVHC requirement should be part of the assessment for use of the raw material in the 1st life concrete.

FINALLY

The drafted assessment system has been published as a CROW-CUR Guideline. The intention is to gain practical experience with it, for example, in projects. Also, when drafting a CROW-CUR Recommendation for new raw materials, this Guideline will be used to assess the circularity of the concrete produced with it. Once these experiences have been evaluated and processed, it can potentially be raised to the status of CROW-CUR Recommendation.

Table 3. Generic properties, assessment methods and testing criteria for leaching analysis of crushed concrete with the raw material

PROPERTY	UNIT	ASSESSMENT METHOD	TEST CRITERION
Leaching	mg/kg ds	NEN 7383	Maximum emission value granular building material
Composition	mg/kg ds	AP04-SB	Maximum content of building material

SGS INTRON contributes to the ongoing development of 3D printed concrete

For more information contact: Gert van der Wegen gert.vanderwegen@sgs.com

Eindhoven University of Technology has rapidly established a world-leading position in the field of 3D printing of concrete. To a large extent this is thanks to input from a consortium of companies, including SGS INTRON, and financial support from the Dutch Research Council (NWO).

Following the successful completion of a first program, two research topics have now been launched:

- **3D PRINTING OF FUNCTIONAL SPECIFIC PERFORMANCE CONCRETE**

  This research involves the development of new 3D printed materials with specific functions such as energy management, self-healing and self-cleaning, longevity, etc.

- **3D PRINTING OF DURABLE CONCRETE FOR NET ZERO ENERGY BUILDINGS**

  This research is specifically focused on substantially reducing the CO_2 emissions associated with current cement-rich printing mortars, and energy storage/generation for achieving energy-efficient buildings. The circularity of 3D printed concrete will also be considered in detail.

Again we are contributing our knowledge and experience to both research programs, which will run for four years. We are also making our research facilities available and contributing financially. With this research, we are bringing 3D concrete printing a step closer to large-scale application in Dutch practice and further expanding our world-leading position.

The other companies in the consortium are: BAM, CRH, Nanocyl, Van Wijnen, Weber Beamix and

UKCA certificate mandatory in the UK from 1 January 2023

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From January 1, 2023, the regular European CE mark will no longer be accepted in the United Kingdom. As a result of Brexit, from January 1, 2023 products must bear the UKCA mark.

Since the United Kingdom officially left the European Union on January 31, 2020, a replacement for CE marking has been introduced, namely the UKCA mark, which stands for UK Conformity Assessed. UKCA marking allows products to be admitted to the UK market and traded there. The marking came into effect on January 1, 2021. It was previously announced that the transition from CE to UKCA marking had to be completed by January 1, 2022, but this has been extended to January 1, 2023.

Application of UKCA marking applies to Great Britain, i.e. England, Wales and Scotland. Northern Ireland remains part of the European Free Trade Area, so CE marking continues to apply there.

EU REGULATIONS ARE PARAMOUNT FOR BRITISH COMPANIES TRADING WITHIN THE EUROPEAN UNION

From January 1, 2023, the European rules whereby products can be traded freely within the European Union will no longer apply to Great Britain. CE-marked products will no longer be automatically recognized there. Conversely, the same applies to British companies that want to trade their products within the European market. They must comply with European regulations on CE marking.

UKCA MARK FOR BUILDING MATERIALS AND PRODUCTS

SGS is an approved body for UKCA marking of building materials and products, and can help your company achieve a smooth transition. We can assist you with obtaining approval of your products for the UK market, and CE marking as well. Please get in touch if you would like more information.

50 years of SGS INTRON: A timeline of key events

1971

INTRON founded in Maastricht with Egid Niël as director. It provides research and consulting services relating to cements, concrete and stony materials

It does pioneering work with workforce growing gradually to around 25 by the late 1970s

1978

Jan Bijen appointed director of INTRON

1981

Research on the durability of concrete with blast furnace cement for the Bahrain Causeway

Se

Own
res

1998

The Consultancy project group obtains ISO 9001 certification

2000

Management buyout from Tauw: INTRON stands on its own feet again and begins extensive employee participation

2001

Participation in BouwQ, a Technical Inspection Service promoting risk-based inspection

BDA-INTRON becomes INTRON

Certification without input from BDA

2002

INTRON develops Rollpave and receives ID-NL award for this innovation

2005

Takes over the Stikkers inspection company, begins VCA inspections

Investigates the collapse of the Patio Sevilla balconies in Maastricht and, from there, several major collapses in the Netherlands

2007

Enters into collaboration with Shell for the development of sulfur concrete

2020

Organizational changes within SGS INTRON to enhance sales activities and digitalization, among other things

2021

SCC inspection activities discontinued

Assists The Ministry of Infrastructure and Water Management with innovative concrete mixtures for test site on the Afsluitdijk

2022

50 years of SGS INTRON!

50 YEARS SGS INTRON

Logos from SGS INTRON, from the past to the present

1983

rvices expanded to include granulates, damage and other construction materials, as well as soil

cement production launched as part of earch with clinker kiln (barium cement)

1988

Certification department launched

1989

Relocation from Maastricht to Sittard

Later also Houten, Geldermalsen and Culemborg

1995

Merger of certification activities with Bouw Dak Advies (BDA) to form BDA-INTRON: a broad certification body covering all fields including roofing and insulation materials

1992

Coating investigation for Eastern Scheldt Storm Surge Barrier

Femmasse launched: finite element software that models cooling in young concrete

Establishment of and participation in the STEK certification scheme for reducing CFCs in refrigeration plants

1990

Laboratory receives STERLAB accreditation (later RvA L017)

2008-2009

Twice nominated Best Managed Company (Deloitte)

2010

All INTRON activities acquired by SGS. Name changed to SGS INTRON and SGS INTRON Certification

2012

Management change. Wim van Loon becomes (interim) director of SGS INTRON

Start of production quality control and construction of lock complexes in Antwerp, IJmuiden, Terneuzen

2017

Metal laboratory started

2015

Management change. Ron Leppers becomes director of SGS INTRON

2014

Asbestos certification activities discontinued, while continuing to cooperate with SGS Nederland on management system certification

Monitoring reinforced geopolymer concrete – initial results are positive

For more information contact: Michel Boutz michel.boutz@sgs.com

In 2020, for the first time in the Netherlands, civil contractor Mobilis/TBI built a structural component from reinforced geopolymer concrete: a dividing wall in a railway underpass in the town of Heiloo. This type of concrete has a more favorable environmental profile than traditional cement concrete, due to the use of geopolymer as a binding agent instead of cement. At the time, this Bulletin reported SGS INTRON's plan to monitor the behavior and properties of this sustainable concrete over a period of ten years. This would involve high-tech sensors built into the dividing wall and periodic visual and destructive tests on a reinforced (test) wall of the same material. We are now two years further on. Initial results are positive: "For example, we see that the strength of the geopolymer concrete continues to increase over a long period."

TEST WALL TO MONITOR MATERIAL BEHAVIOR

The test wall was built because the dividing wall in Heiloo cannot be inspected and destructive testing is not allowed there. On the side of the underpass the wall is tiled, on the other side there is (wet) soil. The test wall was created to allow inspections to be carried out and to monitor changes in the properties of the material over the years on the basis of samples. "It was transported from Heiloo in three pieces to an outdoor site in Nederweert," says project manager and senior consultant Michel Boutz from SGS INTRON. "We can get there easily from Sittard to carry out research and inspections."

CORE SAMPLES EXAMINED IN THE LAB

The reinforcement in the test wall is exactly the same as that in the dividing wall of the underpass. "For reinforced structures, it is important to know the resistance to chloride penetration," says Michel Boutz. "Deeply penetrating chlorides can corrode the reinforcement. For that

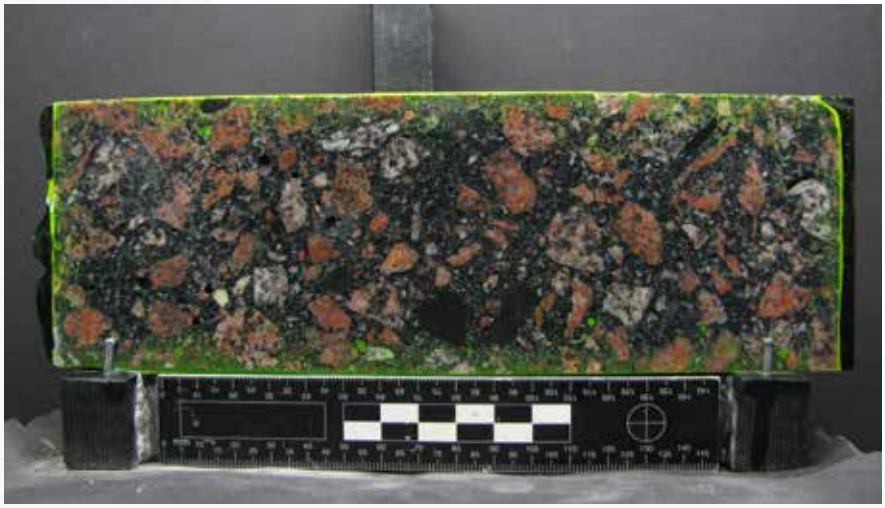
reason, we spray the test wall with a road salt solution during the winter months to simulate the effects of de-icing salt. We will also carry out destructive testing after one, three, five and ten years. This was done for the first time in 2021. Core samples taken from the test wall were subjected to detailed examination in SGS INTRON's laboratory. As well as resistance to chloride penetration and carbonation, we also measured the compressive strength of the material. A potential risk of geopolymer concrete is that strength will decrease after a certain time. Our research indicates that this is not the case with this material."

ANNUAL TECHNICAL INSPECTION

SGS INTRON also conducts a technical inspection of the test wall every year. Michel Boutz says: "We use non-destructive methods, like half cell potential measurements to obtain information about the condition and possible corrosion of the reinforcement. We also carry out a visual inspection of the wall, to assess the condition of the concrete and look for any damage. "The test wall faces harsher conditions than the geopolymer concrete dividing wall. After all, this wall stands outside in all weathers and has to cope with de-icing salt. "We note that the material is susceptible to dehydration. For this reason, we have to treat the cores in the laboratory differently to cores of traditional concrete. The different composition also alters the material's resistance to carbonation. Accelerated tests performed in the laboratory have already demonstrated a high resistance to chloride penetration. At the end of the ten-year period, we will do another chloride profile test to confirm this."

A STEPPING STONE TO WIDER APPLICATION

Measurements on the test wall are difficult to compare with those taken by sensors in the dividing wall in Heiloo. The latter provide real-time information about the deformation of the wall and the risk of reinforcement corrosion. "We can see from the measurements so far that the dividing wall is very stable – there is little change." Of course, that has a lot to do with the conditions of the dividing wall. It is completely built-in and well protected against dehydration and chloride penetration, among other things. Michel Boutz adds: "The research on the test wall gives us a lot of valuable information about how the material behaves under more difficult conditions. Positive results may be a good reason to apply the material in more projects. A study is currently underway to apply a similar geopolymer concrete on a larger scale in a (railway) underpass. We are currently conducting a validation study to determine whether the material is suitable for this. Geopolymer concrete is attracting a lot of attention. Initial findings with structural applications are encouraging. But of course we are only at the beginning of a ten-year research program."



Certification of mattress recycling companies

For more information contact: Ulbert Hofstra ulbert.hofstra@sgs.com

Every year, 1.6 million mattresses are discarded in the Netherlands. The Mattress Recycling Netherlands (MRN) foundation was established by five major mattress manufacturers and importers to ensure high-quality recycling of this large volume of mattresses. The five founders of MRN are Ikea, Beter Bed, Koninklijke Auping, Swiss Sense and Hilding Anders. MRN's goal is to recycle more mattresses and incinerate as few as possible. A specific target is to have 75% recycled mattresses by 2028.

Mattresses are recycled by separating them into their various components:

- PU foam
- Other foam (different types)
- Metal (from box springs)
- Textiles (the outside of the mattress)
- Various other materials (horse hair, sheep's wool).

Such materials from old mattresses are turned into all manner of new things, such as insulating material, carpet underlay, dashboards, judo mats and a host of other useful products.

WASTE MANAGEMENT FEE AS OF JANUARY 1, 2022

MRN submitted a producer responsibility proposal to the Dutch Ministry of Infrastructure and Water Management, and the Ministry declared it generally binding. From January 1, 2022 onwards, all mattress manufacturers, importers and distributors are now legally required to pay a waste management fee for all mattresses marketed in the Netherlands. Out of this fee, MRN compensates waste collectors such as municipalities, waste recycling points, shopkeepers and retailers. This is done by reimbursing an annually increasing percentage of the costs.

The MRN Foundation is a member of Royal CBM (Koninklijke CBM), the trade association for the interior design and furniture industry, which implements the scheme on behalf of the MRN Board.

COMPLIANCE WITH THE ASSESSMENT GUIDELINE FOR MATTRESS RECYCLING AND FIRST CERTIFICATE HOLDERS

The generally binding declaration includes a requirement for recycling companies processing mattresses to be certified. Royal CBM asked SGS INTRON to formalize this obligation by drawing up an assessment guideline and by having SGS INTRON Certification carry out audits. SGS INTRON prepared an 'Assessment Guideline for Mattress Recycling' in consultation with a focus group made up of representatives of all stakeholders. Besides the MRN Foundation, these included recycling companies and collectors. The Assessment Guideline lays down requirements relating to:

- The operational management of recycling companies and in particular the transparency of figures for incoming mattresses
- Product volumes handled
- Waste and volume of material in storage.

Companies are required to prepare quarterly reports including a mass balance of inbound and outbound flows.

After a trial audit in October 2021, mattress recycling companies Retourmatras and Matras Recycling Europe underwent an admission test by SGS INTRON Certification the following December. On this basis, they were certified with effect from January 1.

Recently, in consultation with the focus group, certain clarifications were made to the Assessment Guideline, particularly regarding the reporting of recycling percentages by companies to MRN. The MRN Board has now adopted this version 2.0 of the Assessment Guideline.

TOWARDS A MORE CIRCULAR ECONOMY

All stakeholders are working together to ensure ever better recycling of mattresses with greater transparency. In doing so, the mattress sector is helping to make the Dutch economy more circular. By implementing collective producer responsibility in this way, the sector is setting an example that can be followed by other industries.

Manufacturer's Self-Declaration for Rockflow water management product

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As a result of climate change, the number of extreme rain events has increased by sixty percent since the 1960s. Rockwool has developed a new stone wool product that addresses this development: Rockflow. Unlike the insulation products the company markets, this product does not have a water-repellent coating. On the contrary: Rockflow is designed to absorb large amounts of water – up to 95 percent of the volume – and release it gradually. This makes the modular elements highly suitable as an underground water buffer, for example under a parking lot. Els Huynen, Quality Engineer at Rockflow, notes that demand for this new product is rapidly increasing. "Municipalities that have used it are coming back for more. Fortunately, since June we have a Manufacturer's Self-Declaration, based on batch inspections and admission testing by SGS INTRON. This means we can now deliver directly – without additional batch testing."

MANUFACTURER'S SELF-DECLARATION UNDER THE SOIL QUALITY DECREE

Stony building materials must meet the composition and leaching requirements of the Soil Quality Decree (Besluit Bodemkwaliteit). There are three recognized ways of demonstrating this:

1. Batch inspections of every batch
2. NL-BSB product certificate based on an Assessment Guideline
3. Manufacturer's Self-Declaration

A Manufacturer's Self-Declaration is the best choice when there is no Assessment Guideline for the product in question and consistent product quality is required. For a Manufacturer's Self-Declaration, the results of ten batch inspections must be available and the parameters to be tested must be well below the maximum values specified in the Soil Quality Decree with a limited spread. After a one-time audit by an approved certification body, a Manufacturer's Self-Declaration can be drawn up. This is registered by the Dutch government on its website.

TEN BATCH INSPECTIONS

With a Manufacturer's Self-Declaration, the producer shows that the environmental quality of the product stays within a narrow bandwidth over a prolonged period. It also shows that the product more than meets the requirements of the Soil Quality Decree (Besluit Bodemkwaliteit) with regard to the composition of organic components and leaching of heavy metals and salts. "The Rockflow product is made of stone and classified as a building material based on the proportions of silicon, calcium and aluminum," explains Huub Creuwels of SGS INTRON. "When used on or in the soil it falls within the scope of the Soil Quality Decree. Rainwater flows into the Rockflow elements, after which it slowly infiltrates or drains into the soil. With a series of ten batch inspections (leaching tests) spread over several years, we have demonstrated that Rockflow always remains well below the defined limit values and has a constant environmental quality."

ADMISSION TEST

Where this is the case, a producer can draw up a Manufacturer's Self-Declaration on the basis of ten batch inspections. SGS INTRON Certification conducted a final audit for this purpose. "During this audit, the admission report and the quality system at the production location were assessed. This was to independently verify whether production is guaranteed to remain within the desired quality bandwidth. That was indeed the case, which led to recognition of the Manufacturer's Self-Declaration." Rockwool regularly refers to it. "The Manufacturer's Self-Declaration can be found on the website Bodemplus.nl operated by the Dutch Directorate-General for Public Works and Water Management (Rijkswaterstaat). This was a great solution for us. Because this is a new product for the Netherlands, there is no Assessment Guideline on the basis of which we could obtain NL BSB® product certification. Now, though, we have a nationally recognized environmental quality declaration."

MULTIPLE VARIANTS COVERED BY ONE SELF-DECLARATION

Another advantage for Rockwool is that the company can use the same Manufacturer's Self-Declaration to cover possible variants of the original Rockflow product. "There is already one new variant that we want to put on the market. But before we can do that, we have to demonstrate that the modification has no effect on leaching behavior," explains Els Huynen. "At the moment that still requires a separate batch inspection by SGS INTRON." SGS INTRON also regularly performs batch inspections for other stone wool products. "In time this could lead to a second Manufacturer's Self-Declaration," hopes Els Huynen.

ACCESS TO THE EUROPEAN MARKET

Meanwhile, as far as Rockflow is concerned the company has for some time been looking beyond the Netherlands. "We want to enter the European market," says Huynen. "For that reason we are working on getting the CE marking. Rockflow is not covered by any European standard, so we are now having a European standard or European Technical Assessment (ETA) written. This will cover not only the environmental but also the structural properties of the product. SGS INTRON will conduct follow-up measurements for this purpose. The process of obtaining a European Technical Assessment (ETA) – a European quality declaration – is costly and time-consuming. But it is a necessary step, because on the basis of an ETA we can apply for CE marking. This is not applied for very often in the Netherlands, but it is in other countries. First of all we want to expand into Germany. We are now looking to see what else is required for that. "In Germany they also consider eco-toxicity, i.e. whether the quantities of substances that leach out are harmful to the ecosystem," says Huub Creuwels. "Based on the German requirements, we can review our research results and carry out a number of additional checks." Huynen adds: "On that basis, we hope to obtain approval for the German market. Then we will move on to the UK."

Iconic Port House inspected with the aid of drones

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The Port House, headquarters of the Antwerp Port Authority, is an iconic feature of the city's skyline, mainly because of its striking architecture. A modern structure made of glass and steel "floats" on top of a tastefully renovated, heritage listed fire station. If you look carefully, it resembles both a diamond and a ship. It was designed by the well-known architectural firm Zaha Hadid Architects. The superstructure is partly supported by four pillars arranged two by two starting in the central hall – the atrium – and extending through the glass roof into the superstructure. The space between the glass roof of the atrium and the superstructure is difficult to access. To inspect the coatings on these pillars, SGS therefore worked with SkyeBase, a company which specializes in industrial inspections using drones and complies with SSC Petro standards and ISO 9001:2015.

EXAMINING THE CONDITION AND LAYER THICKNESS OF COATINGS

Contract manager Erwin Broeckx of Van Roey Services commissioned the coating survey. "Along with my colleague Katrien Wellens, I was also present that day, for safety reasons. Van Roey Services is one of the many arms of the Van Roey Group, which is well-known for innovative construction methods. We offer turnkey solutions: from development up to and including building management. Van Roey Services is responsible for the architectural maintenance of several buildings in the Port of Antwerp, including those of the Port Authority. Last year they asked us to examine the coatings on the pillars of the Port House. This was because bulges were visible on the coatings of the pillars, probably caused by water infiltration. The Port Authority wanted an inspection of the layer thickness and condition of the coatings and required us to identify possible risks to safety."

KATRIEN WELLENS

ERWIN BROECKX

INDEPENDENT INVESTIGATION

"For Van Roey Services, it is important that such an investigation is carried out by a neutral expert party," emphasizes Katrien Wellens. "That's why we called upon SGS. SGS INTRON is one of only a few companies able to carry out this type of inspection properly. Based on their comprehensive inspection and analysis, we can advise the customer – in this case the Port Authority – on the correct way to proceed."

DRONE DEPLOYMENT THE PREFERRED METHOD

In the very first discussion with SGS, the idea of using drones for this job came up straight away. "We looked at other options," says Erwin Broeckx. "It could possibly be done with aerial platforms, but it would also be enormously difficult and expensive. Hence, I asked SGS if they could carry out the inspection using drones. I had read an article about how SkyeBase uses drones to conduct industrial inspections in the Port of Antwerp. They even deploy drones to guard against illegal discharges by ships into the Schelde River. It seemed to me that a drone would allow us to inspect the pillars of the Port House safely and quickly. And so it proved."

FROM INSIDE THE HALL TO HIGH ABOVE THE ROOF

SGS was immediately receptive to the idea. The company often uses drones to carry out inspections. Moreover, it already has a good working relationship with SkyeBase. In view of its extensive experience with coating inspections, SGS INTRON was asked to carry out the work. Prior to the inspection, SkyeBase carried out the necessary project preparations so that everything could proceed safely and efficiently on the day itself. For example, exclusive use of part of the airspace around the Port House was claimed in order to perform the task. Bart Daniëls was the pilot on duty on November 25, 2021. Under the direction of project engineer Frank van Eijnatten from SGS INTRON, he smoothly piloted several drones equipped with sophisticated cameras along all sides of the pillars. They were deployed outside, above the glass roof, and also inside the hall. The drones got close to almost every part, and within three and a half hours collected a wealth of video footage containing important information for SGS INTRON.

A CLEAR PICTURE, SAFELY AND QUICKLY

"We normally stand next to the drone pilot or follow the inspection on a large screen in SkyeBase's bus, so we can watch along with what the drone is 'seeing'," says Frank van Eijnatten. "The advantage of that is that you can have a picture taken immediately if something strikes you. That wasn't possible here. Two people cannot stand next to each other on the glass roof. However, we did agree beforehand which signs of damage would be photographed come what may. Furthermore, the whole inspection was captured in video images from which we subsequently extracted photos by freeze framing." These are not razor-sharp pictures, but they provide SGS INTRON with enough information to assess the situation properly at various locations. Frank van Eijnatten also carried out a visual inspection and took layer thickness measurements of the coating from the ground, up to a height of approximately 2.5 meters.

EXCELLENT COOPERATION AND A CLEAR REPORT

"The inspection and collaboration were conducted very professionally," Erwin Broeckx recalls. "At the end of the day, the drone pilot showed us some images of moisture pockets in the coating. Then it was a matter of waiting for the report from SGS INTRON. They had to analyze many hours of drone footage." In the end they concluded that technically there is little to worry about. The damage is mainly aesthetic. Especially outside, the coating was clearly not applied with the greatest care and bulges are visible. They are probably caused by moisture that was already present in the cladding of the pillars when the coating was applied. The report is now with the Port Authority. At Van Roey Services they are very satisfied: "It is a clear report with an analysis of the situation inside and outside, as well as possible solutions."

CSI-style investigation into the breakage of a crane arm

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Since 2014, the SGS INTRON laboratory has had state-of-the-art facilities for performing destructive and non-destructive metal tests. This allows us to determine the composition, strength and dependability of metals. In recent years we have also conducted a continuous series of damage investigations on a wide range of objects, from very fine, visual defects in jewelry for example, to very heavy damage, ranging from a broken dredger chain weighing 8,000 kg, to parts of industrial installations, such as shafts. Or, as was the case at the end of last year, parts of the broken arm of a mobile crane.

VISUAL SLEUTHING

The so-called 'mono-jib', the lower part of the arm, broke off completely during operation. This happened while moving iron with a grab, a task that involves frequent and sudden up and down movements with the crane. SGS INTRON was asked to investigate the material properties of the steel used and the exact cause of the material failure. "It starts with a CSI-style visual examination," explains project manager Frank Meijers. "We had asked our client to send us the lower part of the crane arm for examination: the 1.5 meters below the fracture with the broken cylinder and the 1.5 meters above the fracture, so a part of the arm. "We started by looking at the material very closely. We proceeded as one would at a 'crime scene': every detail is recorded and described in detail. Do you see any cracks? What does the fracture look like? Does anything strike you? Sometimes we devote a few days to it. In this case, two things stood out immediately: there was a lot of rust visible on the edge of the fracture, and there was a piece missing at what we considered to be a critical point."

MATERIAL TESTS

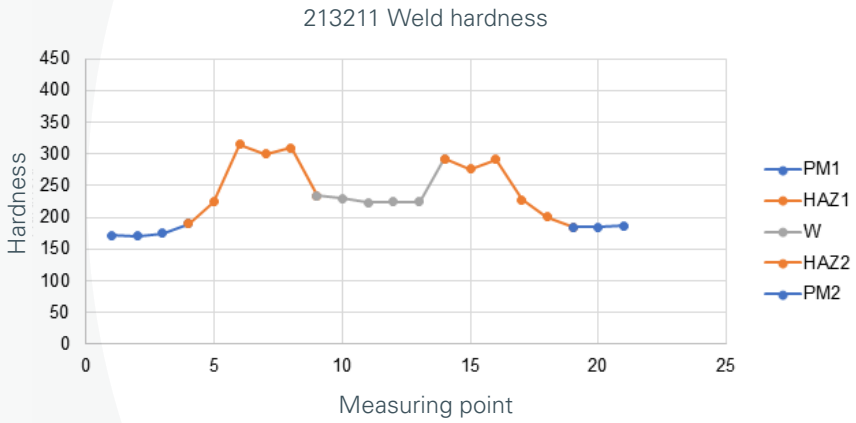
SGS INTRON then investigated the material properties of the steel. To do this, as well as analyzing the chemical composition, they decided to perform a number of tests – tensile strength and hardness – and macroscopic (destructive) testing. "Steel type S355 should have been used for the arm. However, our tests showed that the yield strength and tensile strength of the basic metal of the arm did not meet the specifications for S355."

WHAT WENT WRONG?

"Then we started focusing on the fracture surface," Meijers continues. "Based on what you can see and what you have examined, you try to figure out exactly what occurred. What is the cause? And where did the fracture start? In this case, it began at the rusted section. There were also welds there that did not meet the requirements: their hardness values were so high that they caused stresses in the material. That, combined with the rust formation, made the arm so brittle at that point that the pounding and pulling of the crane caused it to break."

THOROUGH AND CLEAR

With this information, SGS was able to answer the questions of the client – a crane importer – to their complete satisfaction. They now have a clear report in their hands, on the basis of which their supplier can make necessary improvements.



MSWI filler for unreinforced earth-moist concrete

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The need for suitable concrete fillers, especially those with a pozzolanic character, has increased significantly in recent years. This gap can be partly filled by crushed MSWI bottom ash, thereby making good use of this mineral residue. This filler will initially be used in unreinforced concrete products made with earth-moist concrete mortar.

MSWI FILLER

Every year, the Dutch concrete industry uses large quantities of fillers. With the target defined in the Concrete Agreement to reduce the CO_2 emissions of concrete even further – by at least 30% and with the goal of a 49% reduction by 2030 – the need for pozzolanic and latent-hydraulic fillers in particular has increased sharply. However, it is important that the use of such fillers is not at the expense of the quality and circularity of the concrete, since that, too, is an objective of the Concrete Agreement: 100% reuse of concrete waste streams as raw material for new concrete by 2030. MSWI filler can help to attain these goals.

Blue Phoenix Group has developed a process for manufacturing MSWI filler from MSWI bottom ash. A feature of this method is that, after the usual processing, wet grinding is carried out to achieve the desired fineness. This wet grinding can reduce concentrations of components in the bottom ash that are undesirable in concrete, particularly sulfates, chlorides and metallic aluminum and zinc.

RESEARCH

Extensive research has been carried out by Dutch CROW working group N1794 'MSWI filler in unreinforced concrete' into the properties of MSWI filler and its performance in concrete. In this study, both the concrete technology and environmental aspects of the 1st life concrete were determined. Also, the suitability of the raw materials – obtained after recycling this 1st life concrete – was determined as an aggregate and filler in a 2nd life concrete (circularity).

PROPERTIES OF MSWI FILLER

At a large-scale experimental facility, bottom ash from three geographically distributed MSWI plants (Duiven, Rozenburg and Delfzijl) was processed by Blue Phoenix Group into MSWI filler with an average particle size of around 8 µm. This particle size is similar to that of the ground limestone (10 µm) used as a reference in the concrete study.

Despite the differing origins of the MSWI bottom ash used as the raw material before the start of the recycling and milling process, the MSWI fillers produced show only minor variations for the properties tested.

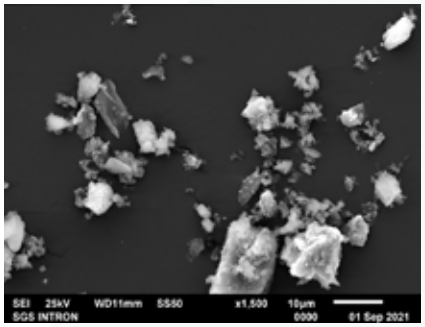

Photo 1 SEM photograph of MSWI filler (SEM = Scanning Electron Microscopy)

CONCRETE STUDY: 1ST LIFE

At a concrete factory, concrete tiles were manufactured under the supervision of SGS INTRON in which 25% (m/m) of the cement was replaced with the three MSWI fillers (photos 2, 3 and 4). As references, concrete tiles were manufactured without cement replacement (REF) and with 25% (m/m) cement replacement by ground limestone (GL).

It appears that MSWI fillers can be used as a partial cement replacement to produce earth-moist concrete products with good (flexural) tensile and compressive strength that is higher than that achieved by the reference concrete (with no cement replacement).

Photo 2 Production of concrete tiles with a small tile press

Photo 3 Pressed tiles

Photo 4 Fracture surface of concrete tile with MSWI filler

CIRCULARITY

The concrete granulate obtained by recycling the three types of concrete tiles (REF, GL and MSWI) has the same particle density and water absorption, hence the granulates are of the same quality. This is also evidenced by research on 2nd life concrete manufactured with these concrete granulates.

Based on this limited study, it is expected that the technological quality of concrete granulate made with MSWI fillers is comparable to that of standard concrete granulate and that therefore the use of this filler does not limit the 2nd life application of this concrete.

Leaching of the concrete granulate without filler (REF) and of the concrete granulate with MSWI filler was determined by a column test according to NEN 7383. This investigation shows that concrete granulate with MSWI leaches the components barium, chromium, copper, molybdenum, and chloride to a greater extent than concrete granulate without filler (REF). In all cases, the amount of leaching is still well within the requirements of the Dutch Soil Quality Decree (Besluit Bodemkwaliteit).

The environmental quality of concrete granulate with MSWI fillers is comparable to that of standard concrete granulate, and 2nd life application is not limited in this respect.

CONCLUSIONS

Based on the studies conducted, we conclude that the MSWI filler produced by Blue Phoenix Group is suitable for use in unreinforced, non-structural concrete products made with dry or earth-moist concrete mortar.

The study also showed that, when MSWI filler is used in these products, the material streams generated when the concrete in question is recycled, can be reused as a raw material in a 2nd life concrete. This application of MSWI filler is therefore fully circular in terms of the aspects within the scope of this study.

REGULATION

CROW-CUR Recommendation 128 was prepared on the basis of the insights gained from the research and sets out definitions, requirements and rules for MSWI filler. The Recommendation applies only to MSWI filler produced from MSWI bottom ash. This must come from a municipal solid waste incinerator with a wet slag remover whereby, in addition to the standard processing steps performed on bottom ash – namely sieving and the removal of ferrous and non-ferrous metals – a wet milling process is also carried out.

The Recommendation applies to MSWI filler used in unreinforced, non-structural concrete products made with wet concrete mortar in a consistency class of C0 (dry) or C1 (earth-moist) and with a maximum MSWI filler content of 140 kg/m3. This upper limit has been defined to prevent excessive lime consumption, which can reduce the freeze-thaw resistance of the concrete.

The performance characteristics required of the MSWI filler are the same as the requirements in Assessment Directive BRL 1804 for each Type I filler (influence on setting time, strength and soundness). Based on the research carried out, the standard requirements for material properties (particle distribution, Na_2O equivalent, methylene blue absorption, chlorides, sulfates) were supplemented by requirements for total organic carbon (TOC) content and metallic aluminum and zinc content.

SUITABLE RAW MATERIAL

The research carried out and the regulations drawn up indicate that MSWI filler is a suitable raw material for use in unreinforced non-structural concrete products made with earth-moist concrete mortar. Furthermore, the application of MSWI filler has been shown to be fully circular in terms of the aspects covered by the study. Consequently, MSWI filler can make an important contribution to achieving our sustainability targets as defined in the Dutch Concrete Agreement.

Research into fouling and algae growth on concrete

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Concrete does not always have a positive image among the general public. It is often seen as gray and dirty. It seems very likely that concrete has been getting dirtier in recent years. Just think of the many noise barriers along highways that turn black or green not long after being built. Why this is so is not entirely clear. Many different reasons are cited. This was one of the reasons that prompted a group from the Dutch Concrete Technology Study Association (STUTECH) to look more closely at the influences behind this gray or green discoloration. Since it was clear that molds, algae and mosses, among other things, contribute to this discoloration, the group was named 'Study Group on Biological Fouling of Concrete'.

STUTECH STUDY GROUP

Another reason for starting this group was the damage caused by moss to some tunnels on high-speed railway lines. A great deal of research has been carried out into this damage and a CROW-CUR final report entitled 'Exploratory research into concrete deterioration combined with moss growth' has been published. There were very strong commercial and political interests behind that commission, so it was not an ideal environment for acquiring new knowledge and sharing it with the industry. A STUTECH study group is ideally suited to this purpose. This is because the participants care about concrete as a material and participate on a voluntary and personal basis, while mostly working for stakeholders. Maarten Swinkels of SGS INTRON was one of the members of this committee.

TEN HYPOTHESES

The study group began with a literature review looking at the various possible factors influencing the occurrence of biological fouling. The final report of the literature review lists the following ten hypotheses:

1. Biofilms are formed more easily because rain is less acidic nowadays, the amount of precipitation has increased and winters are becoming milder.
2. Curing compounds and formwork oil create a breeding ground and accelerate the formation of a biofilm and especially molds.
3. Biofilms damage concrete through acid formation, through penetration and extraction of minerals from the cement stone.
4. The acid production of a biofilm is low, therefore the deterioration is slow and damage is mainly aesthetic.
5. The biofilm serves as a breeding ground for other organisms such as mosses.
6. More acid is created in cushion moss than in a biofilm; the cushion moss also stays moist for longer. As a result, the rate of deterioration is considerably faster.
7. Cushion moss leads to greater frost damage.
8. With cushion moss, damage is caused by frost, bacteria, algae and molds.
9. The rate of deterioration depends on the quality of the concrete surface and thus on the concrete composition, post-treatment, and water-cement factor.
10. The cement type influences the deterioration.

The study group was keen to test these hypotheses and therefore set up a test program in which 110 test slabs the size of a paving stone were made with different cements (Portland cement, blast furnace cement and Portland fly ash cement), different water cement factors (0.45, 0.50, 0.55), different post-treatments (none, film, acrylate and polyvinyl acetate as curing compound), and different release agents (vegetable and mineral oil). These test slabs were exposed with both the case side and the pour side facing upwards. In addition to the various materials, some slabs were also placed in acid rain (rain with the pH of 1980s rainwater) and slabs were sprayed with brine (to simulate road gritting).

A MOSS GROWTH CHALLENGE

SGS INTRON was commissioned to produce, expose and monitor the slabs. The slabs were exposed next to the SGS INTRON building in Sittard in October 2018 and monitored until October 2021.

We expected the exposure site to provide favorable conditions for biofilm and moss to form: the site already had moss growing on it, and the sun can reach it but it is in shade for much of the day. If you have a patio with concrete slabs, you will know that a green deposit often develops all too quickly under these conditions. Yet with our slabs it took eighteen months for any green deposit to develop. On the other hand, a dark discoloration occurred fairly quickly.

RESULTS

This dark gray deposit developed on slabs treated with a curing compound and was caused by molds. Little or no green deposit was visible on these slabs. After three years it was found that no green deposits had formed on slabs made with Portland cement, whereas they did form on slabs made with blast furnace cement, and to a lesser extent on slabs made with Portland fly ash cement. This is due to the low carbonation of slabs made with Portland cement. The biofilm was examined by a moss and algae expert. He identified two types of mold on the

dark surfaces, while red and green algae and yellow lichens were present on the green surfaces. Spraying with brine appeared to cause less greening, while acid rain did not have a major impact.

Unfortunately, no mosses appeared in three years, and attempts to transplant mosses also proved unsuccessful. Therefore, it was not possible to assess whether mosses cause damage.

An assessment carried out after three years and three months did show lichens and perhaps mosses, therefore we want to continue exposing some of the test slabs for two or three more years.

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WHEN YOU NEED TO BE SURE

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