PVC
INFORMATION COUNCIL

The **Stigsnæs** process

Chemical recycling of PVC waste at Stigsnæs

The PVC is converted to the raw materials from which it was originally produced, namely oil, salt, chalk and other minerals.

New era for PVC

Something sensational is happening at Stigsnæs near Skælskør vis-à-vis the Great Belt Bridge. The world's biggest plant for the recycling of PVC waste has now become a reality. The recycling company RGS90 has built the plant, which can process all types of PVC waste. The official opening of the plant, which is already receiving PVC waste, will take place in autumn 2004.

This brochure illustrates by means of a simplified diagram how the process in Stigsnæs operates. It is a chemical process in which the PVC is primarily converted to the raw materials from which it was originally produced, namely oil, salt, chalk and other minerals. The process is unique, for one thing, in that the problematic heavy metals that are present in older PVC waste are removed from the recyclable raw materials.

In building the plant at Stigsnæs, we hope that the PVC debate will take a new turn. Having previously focused exclusively on the waste phase, it should now also focus on the material's excellent technical qualities and on the environmental advantages that are also associated with the use of PVC. There are after all good reasons why PVC has become as widely used as it has during the last 50 years – it is thanks to its properties: flexibility, versatility, durability, light weight, low maintenance, the fact that it is fire-retardant and that it is produced partly from inexhaustible resources.

Ole Grøndahl Hansen
Director, mag. Art.
PVC Information Council 2004, Denmark

Advanced technology

The technology at the Stigsnæs plant is very advanced and remarkable for a range of machinery that extends from the crudest to the most refined forms. When the PVC waste arrives at Stigsnæs, the first processing takes place using a very big shredder, built for breaking up such things as cars. To complete the process, modern nanotechnology is used when the heavy metals are to be removed from the salt molecules.

Handling of both flexible and rigid PVC

The special feature of the Stigsnæs plant is that the process can accept both hard and soft PVC waste. That is to say that waste fractions that are currently deposited can also be recycled at Stigsnæs. This applies to, for example, floor coverings, tarpaulins, tents, roofing materials etc. Metal parts in the waste do not impede the process, and it is not a problem if the PVC waste contains other plastic fractions.

High capacity

When the plant is finished, it will have the capacity to recycle 50,000 tonnes of PVC waste per year. As we in Denmark do not generate that much PVC waste, the idea is that the whole northern European region, will send PVC waste to Stigsnæs.

Heavy metals separated out

One of the special problems with PVC waste is that much of the waste contains heavy metals. A characteristic and very positive feature of the Stigsnæs process is that the heavy metals are separated out during the process. This means that the products into which the PVC waste is converted do not contain heavy metals. The heavy metals can subsequently be used or deposited.

Symbiosis

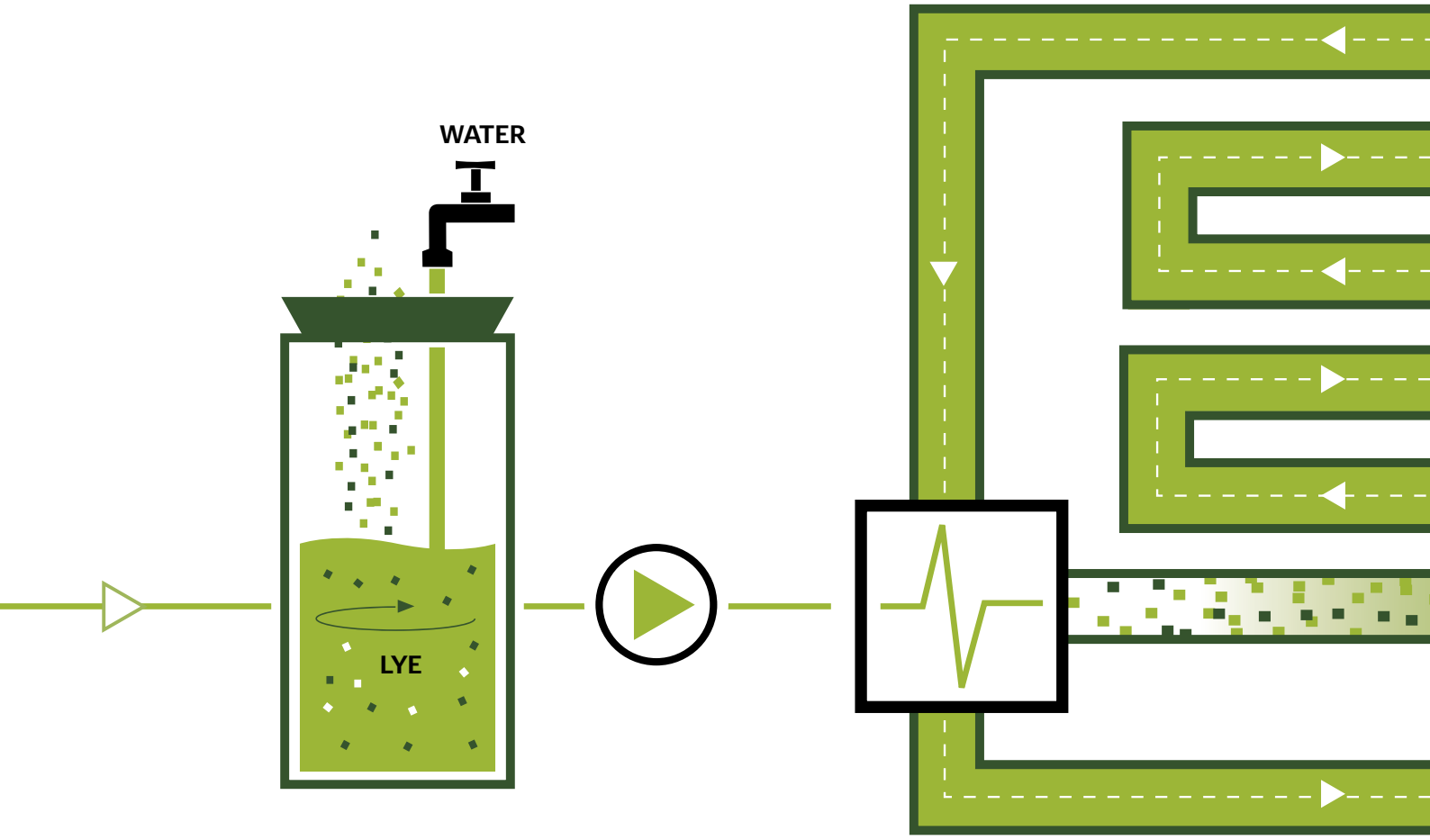
Next to the PVC plant in the Stigsnæs industrial park, a big plant has been built in which sewage sludge is utilised for the sand blasting material Carbogrit. By siting the two processing plants next to one another in an industrial park, an industrial symbiosis has been achieved, in which some of the products from one process are used as raw materials in the other. In addition, the surplus heat from one process is used as processing heat in the other. Both the Carbogrit plant and the PVC plant are the first of their kind in the world and it will be possible to set up similar projects, individually or together, in other places around the world. Both processes are patented world wide.

01 PVC waste

Both flexible and rigid PVC are accepted. No requirements are made as to the cleanliness of the waste. Rubble, metal fittings, soil, concrete etc. are accepted, as well as large or small amounts of other plastic fractions.

02 Preliminary treatment

A shredder unit and two granulators reduce the waste to 10mm. Unwanted fractions such as metals and stones are automatically taken out and sent for recycling or utilisation. Only PVC and other plastics go on to the next stage of the process.



03 Mixing

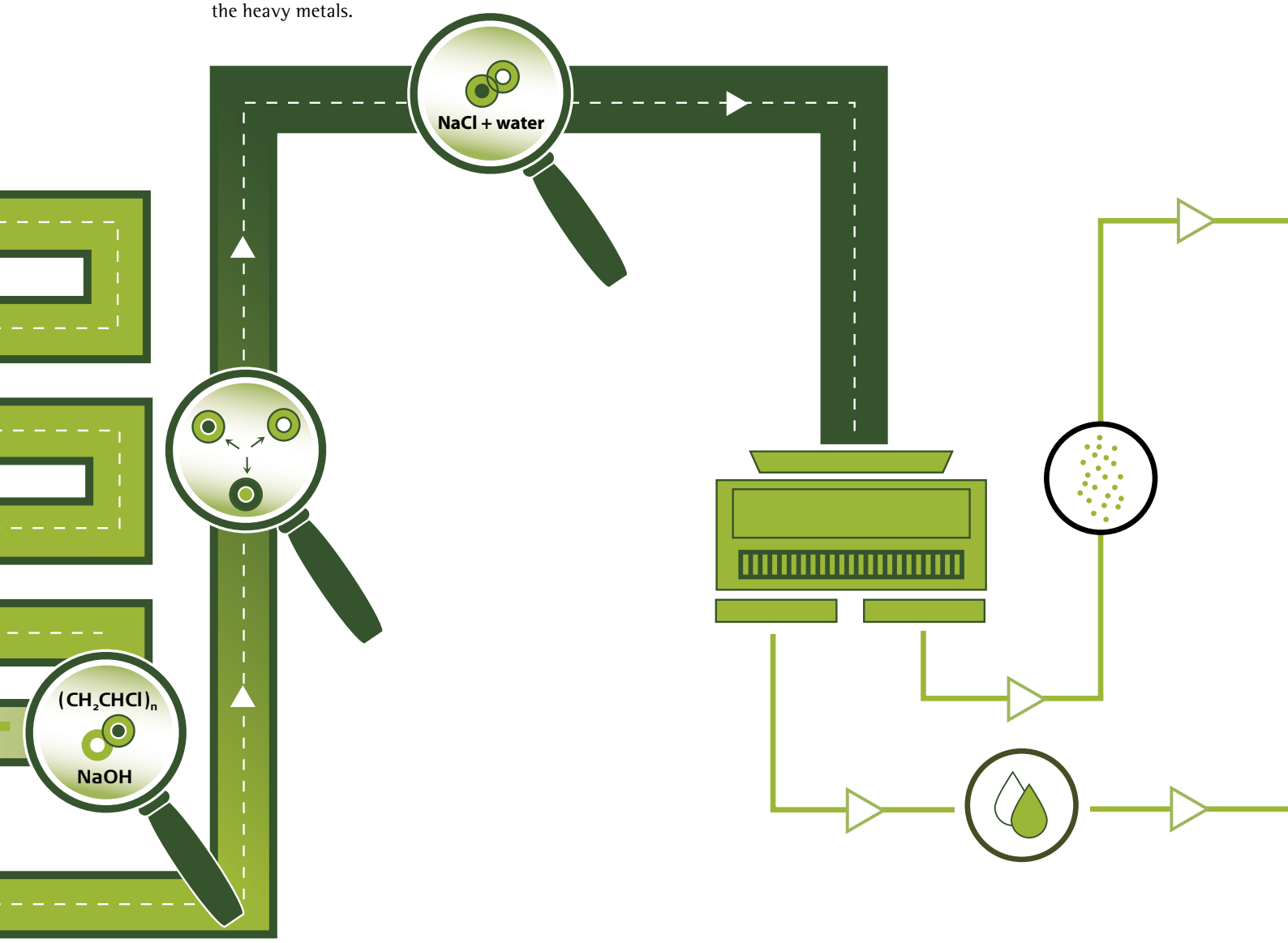
The PVC waste is mixed with water and spent lye (NaOH) to form a fluid pumpable substance.

04 Hydrolysis

The substance goes through a hydrolysis process (boiling under high pressure), during which chlorine is separated from the PVC and sodium is separated from the lye, so that they together form sodium chloride (salt). Salt is the first product to be produced by the process. Hydrolysis takes place in a 4 km long pipe system.

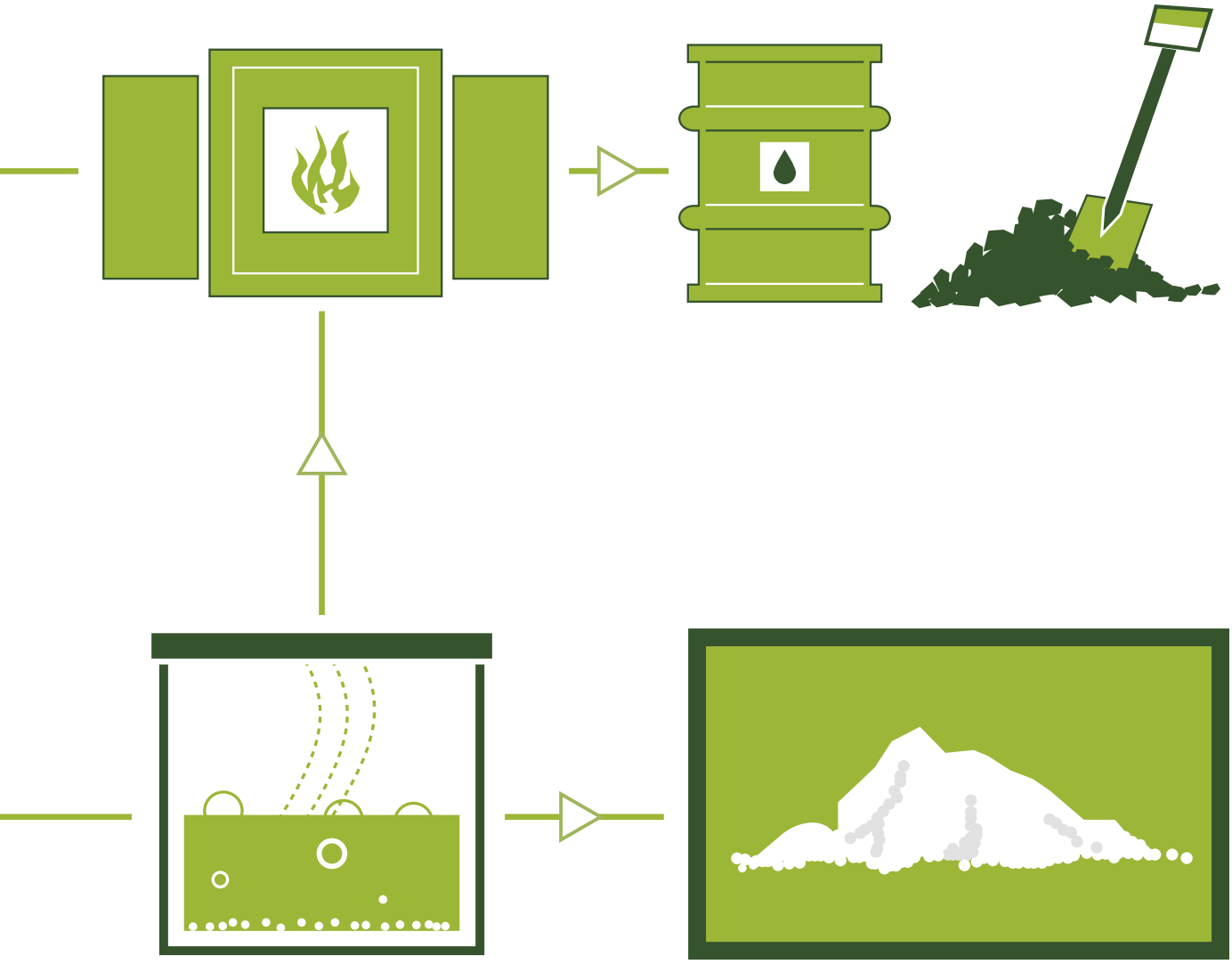
05 Separation of dry and fluid substances

After hydrolysis, the substance is divided into a liquid fraction and a dry fraction. The dry part consists of PVC waste, from which the chlorine content has been removed. The wet part consists mainly of salt water, some of the phthalates and the heavy metals.



06 Pyrolysis

The dry part now undergoes a process of pyrolysis, which means that it is heated and decomposed into oil and coke. All the phthalates in the PVC end up in the pyrolysis furnace and are converted into oil. All the heavy metals end up in the coke fraction and are purified by the Carbogrit process. The coke from the PVC waste replaces new coke in the Carbogrit process. Lime and minerals in the coke fraction become part of the Carbogrit end product. The oil goes to the refinery.



05a Nano filtering

In order to purify the salt fraction, a nanofiltration process is carried out, which only allows salt molecules (sodium chloride) to pass through. The major part of the pollution by other substances is kept back.

05b Salt evaporation

Salt distillation is carried out mainly by using surplus heat from the production of Carbogrit. The salt can be used for road salt or for the production of PVC. It is produced to meet a well defined specification and completely free of heavy metals.

Useful web addresses

The PVC Information Council website: **www.pvc.dk**

Vinyl 2010's website: **www.vinyl2010.org**

RGS90's website: **www.rgs90.dk**

Support from many quarters

The idea of converting PVC waste at Stigsnæs was conceived in 1998. Since then, the project has attracted attention and support from various groups and many have given financial support.

Support from the European Commission

The European Commission gave a subsidy of 3.6 Mio Euro to the Stigsnæs project. The money was spent to set up the full-scale plant and to show that the process was applicable for a substantial period of time. EU cooperation also includes a duty of information for Stigsnæs, so that others in Europe who are working on recycling projects for PVC can benefit from the experiences at Stigsnæs.

Support from the Environmental Protection Agency

The Danish environmental authorities have also been involved in the Stigsnæs project. The Environmental Protection Agency offered financial support in the start-up phase and they have been represented on the steering group that was set up.

Support from Vinyl 2010

Through the organisation Vinyl 2010, the European PVC industry has pledged itself to finance the development of various technologies for disposing of PVC waste in Europe. The Stigsnæs process received a sum of 3.6 Mio Euro from Vinyl 2010 towards helping setting up the plant. Technical experts from the European PVC industry have followed the process closely and offered advice throughout the whole procedure.

Tanks in which the PVC waste is mixed with lye and water 01

The pump that pumps the PVC waste around the system 02

The four-kilometre-long pipe system, in which the hydrolysis takes place and the chlorine is separated from the PVC 03

Using nanotechnology, the heavy metals are filtered from the salt molecules 04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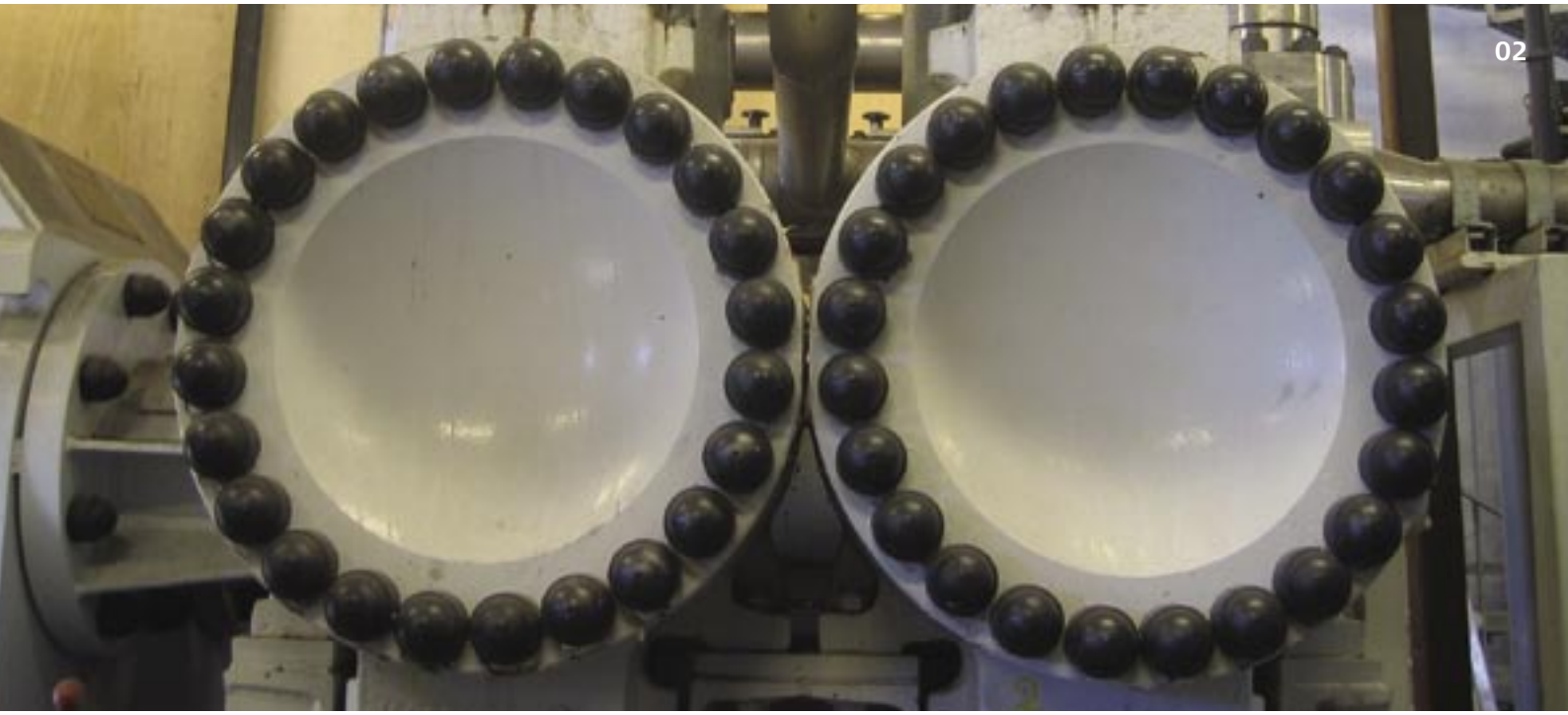
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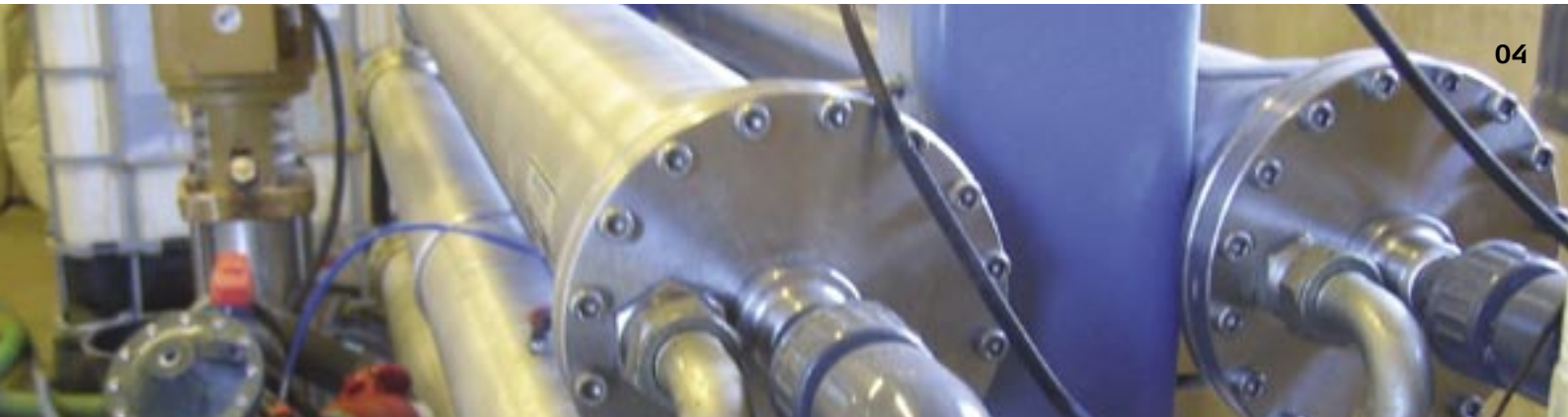
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PVC waste is recycled

PVC is originally produced from salt (57%) and oil (43%). In Europe a good 5 million tonnes of PVC are produced each year. The salt that is extracted from the PVC waste can be reused by the PVC industry to produce new PVC or as road salt. The oil fraction can be used to replace crude oil in industrial processes. The minerals extracted from the waste will be used to produce the sand blasting material Carbogrit.

COSMOGRAPHIC / COSMOPRINT / CS GRAFISK

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