

Working for the end of waste



> REMEX Mineralstoff GmbH

Industrial waste management, production of secondary aggregates, remediation services, landfill management and stabilisation & backfilling of disused mines

remex.de

Facts & figures REMEX

Specialist for mineral waste



- Subsidiary of the REMONDIS Group
- Market leader in the Netherlands and Germany for the processing of municipal solid waste incinerator bottom ash
- Market leader in Germany for recycled aggregates from construction and demolition waste
- Over 60 business locations in Europe and Asia
- More than 35 recycling and processing plants
- 650 employees
- Turnover > 400 million euros

Facts & figures REMEX

Main material flow

> Material input

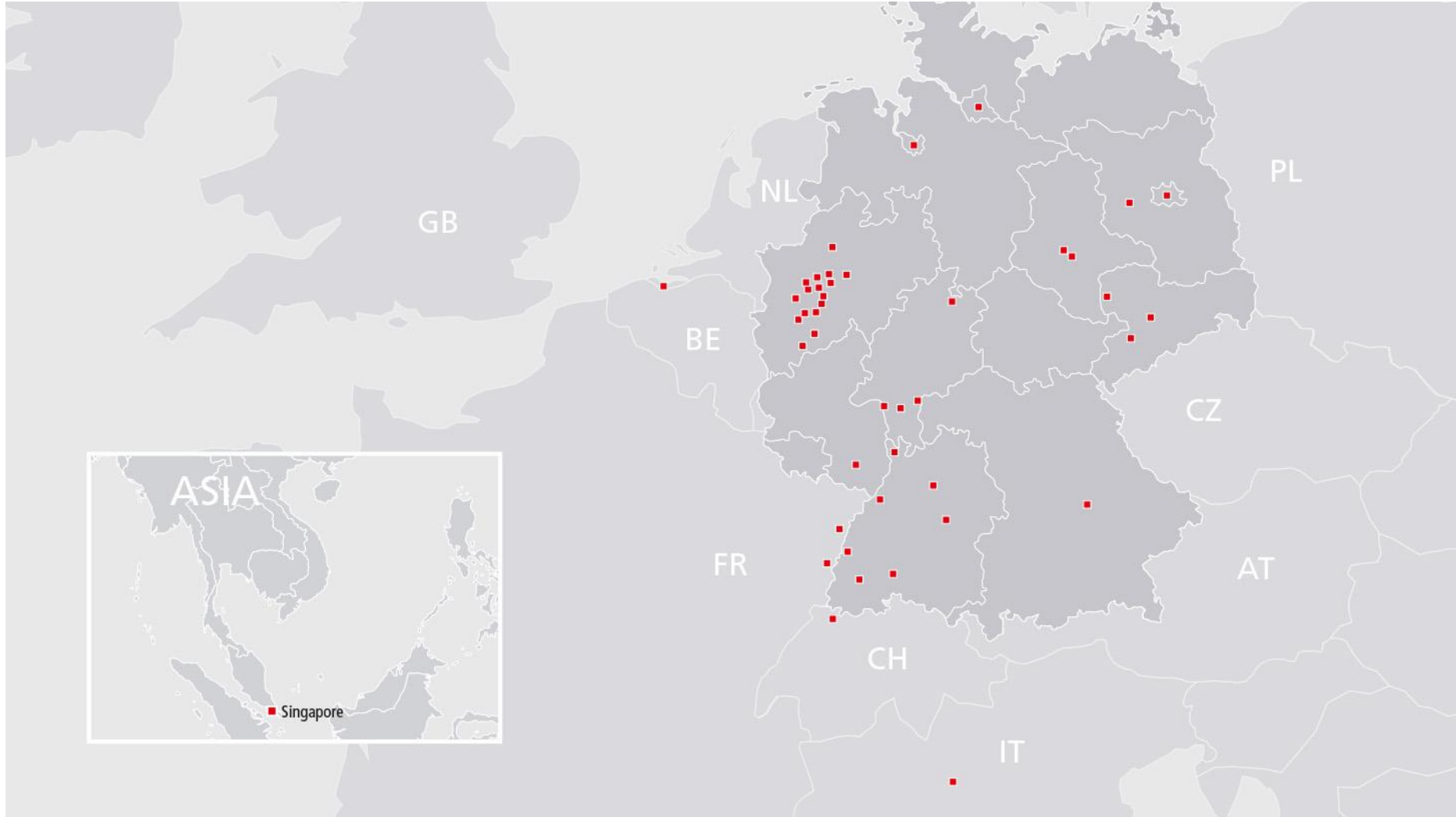
| | |
|---|---------------|
| Construction and demolition waste | 2,300,000 t/a |
| Ash / Slag from waste incineration | 2,500,000 t/a |
| Soil / Earth and other mineral waste | 2,800,000 t/a |
| Dust, slag, ash from industrial processes | 1,000,000 t/a |

> Material output

| | |
|--------------------------------|---------------|
| Recycled aggregates remexit® | 2,200,000 t/a |
| Secondary aggregates granova® | 1,500,000 t/a |
| Ferrous and non-ferrous metals | 320,000 t/a |

Facts & figures REMEX

Locations in Germany, Europe and Asia



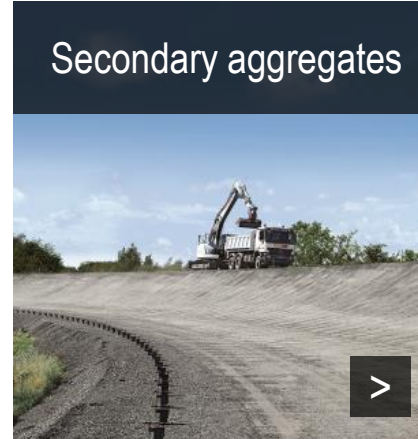
REMEX competences

Specialist for mineral waste

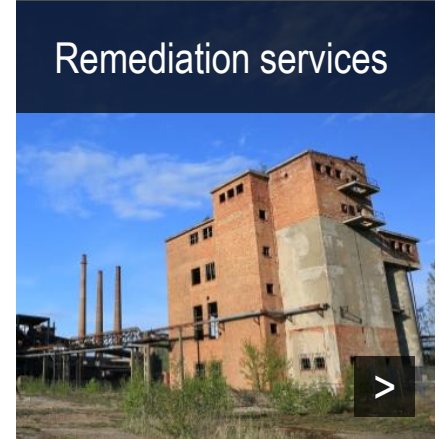
Mineral waste management



Secondary aggregates



Remediation services



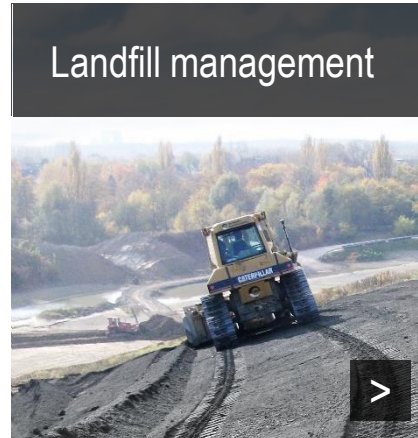
REMEX Processing



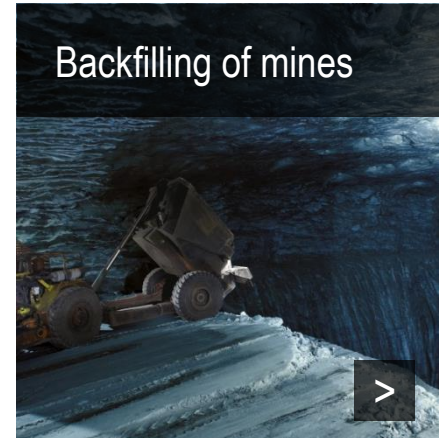
REMEX Solutions



Landfill management



Backfilling of mines



REMEX Mineral waste management



Mineral waste management

From waste to resource



Mineral waste management

From waste to resource



We accept and recycle a complete range of mineral waste such as:

- Construction and demolition waste
- Incinerator bottom ash (IBA)
- Industrial waste, e.g:
 - Slag and dust from smelting
 - Sand and ash
 - Mineral waste containing oil
 - Refractory material
 - Waste blasting media
- Railway track ballast



REMEX

Secondary aggregates

Secondary aggregates

Ecological and economic alternatives



- Production of secondary aggregates from mineral waste materials – e.g. from construction and demolition waste, incinerator bottom ash and railway track ballast
 - Technically comparable to primary construction materials
 - Economically interesting alternative
 - Sustainable solution saving resources and reducing the need for landfill
- Areas of application defined by environmental and technical regulations
- Certification system verifying high quality

REMEX

Remediation services



Remediation services

Recovering lost ground



Creating new value from disused sites:

- Detailed project conception and planning
- Accompanying the permission process
- Remediation of contaminated sites
- Controlled deconstruction of industrial sites
- Treatment or disposal of contaminated soils
- Material analysis and documentation

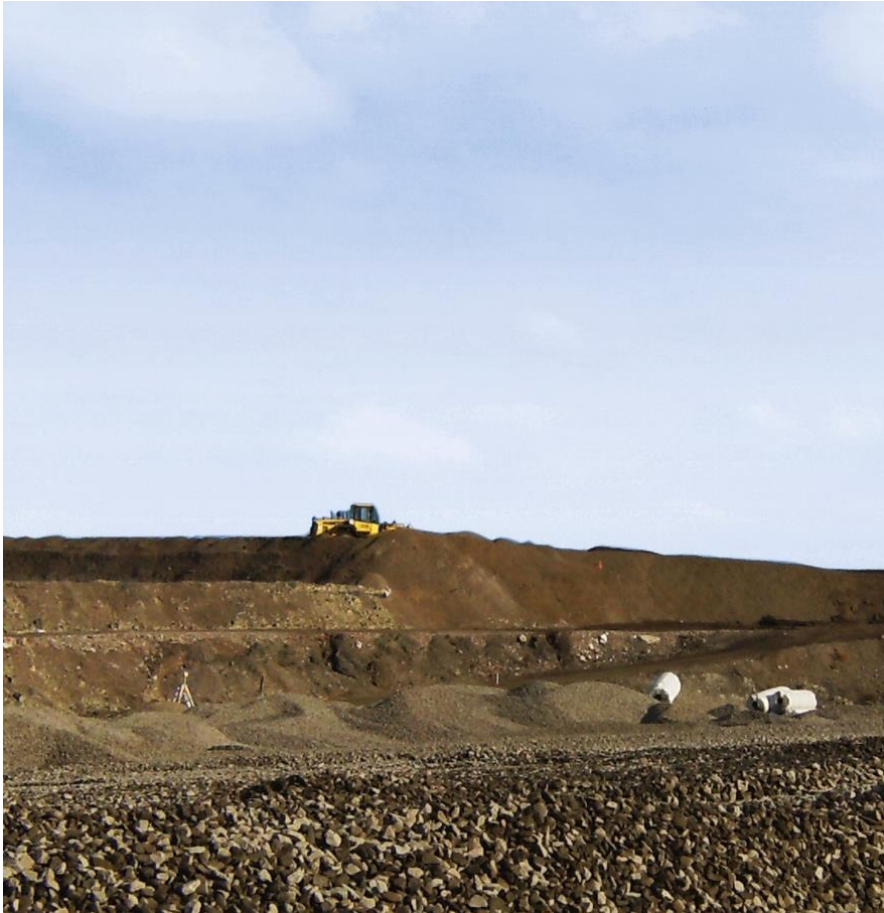


REMEX

Landfill management

Landfill management

Safe and sustainable



- Design, construction and management of landfill sites of all classes
- Experience with hazardous and non-hazardous waste sites
- Reliable partner, ensuring increased economic viability
- Provision of all financial securities for construction, operation, closure and post-closure

Landfill management

Safe and sustainable



REMEX

Backfilling of mines



Backfilling of disused mines and fly ash treatment

Services deep in the ground



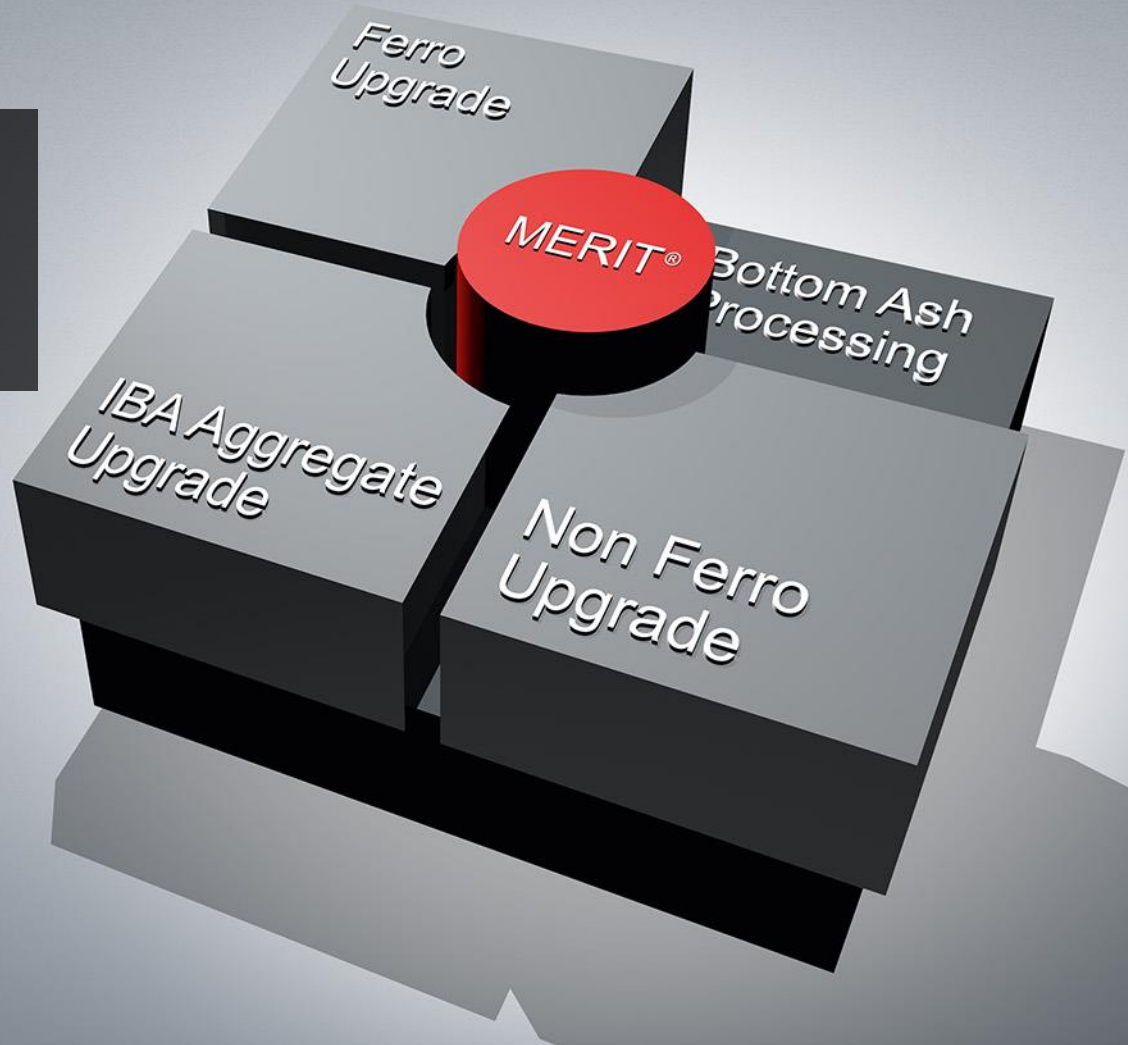
Backfilling of disused mines and fly ash treatment

Services deep in the ground



- High-quality backfilling solutions providing maximum stability in mining sections that are no longer operational
- Production of resource efficient stabilisation material using mineral waste
- Backfilling using state-of-the-art technology, applying different methods – Big Bags, loose or high consistency placement
- Officially certified proof of long-term safety

REMEX Processing Recycling technologies



REMEX Processing

Innovative recycling technologies



- REMEX Processing is a modular technology concept in which we bundle our competence in regard to IBA processing.
- We offer technical solutions for optimum recycling rates of ferrous and non-ferrous metals.
- Additional technologies such as TRIPLE M or HMT enable the production of high quality products from the mineral IBA fraction.
- Unique to the market is our new Non-Ferro technology MERIT®. Its implementation increases NF metal recovery by 15 %.

REMEX Processing

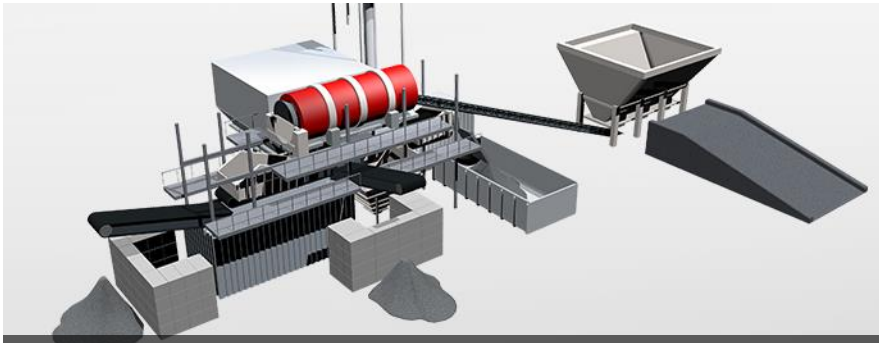
Innovative recycling technologies



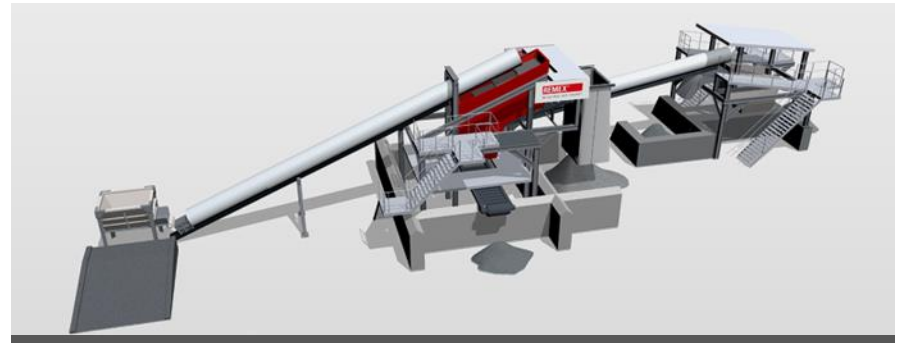
MERIT® Metal Recovery Intelligence > more



Non-Ferro Upgrade Facility > more



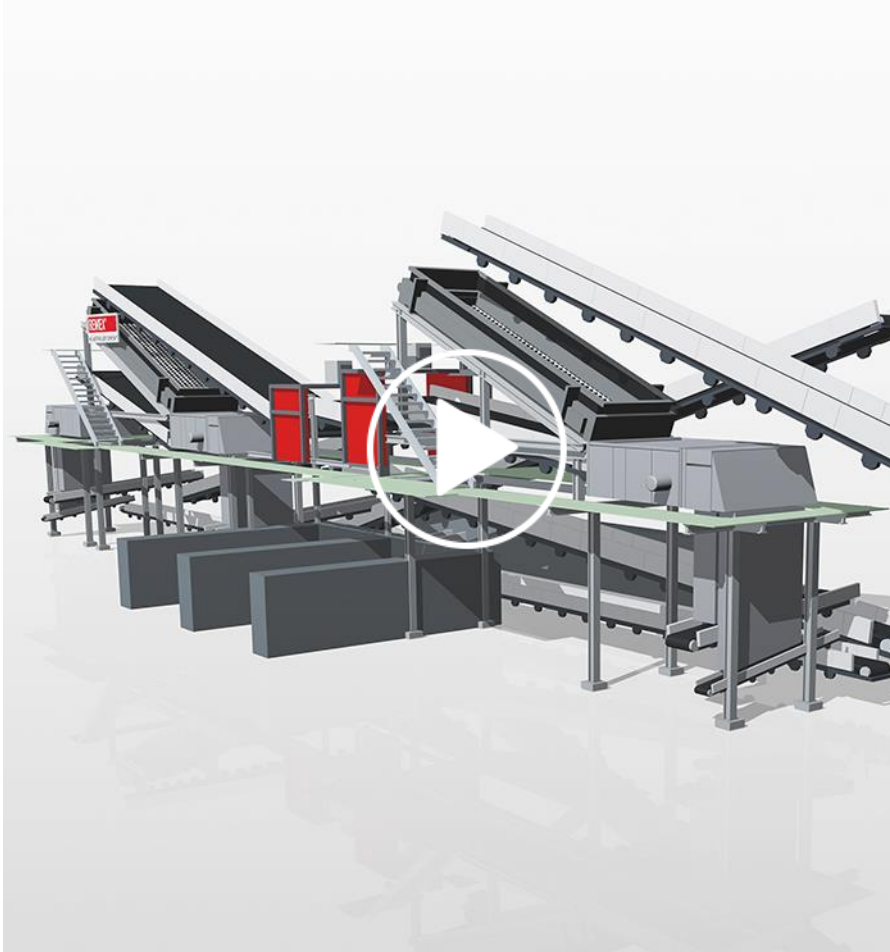
HMT Hydromechanical Treatment > more



TRIPLE M Sieving Technology > more



REMEX Processing MERIT® for higher metal recovery



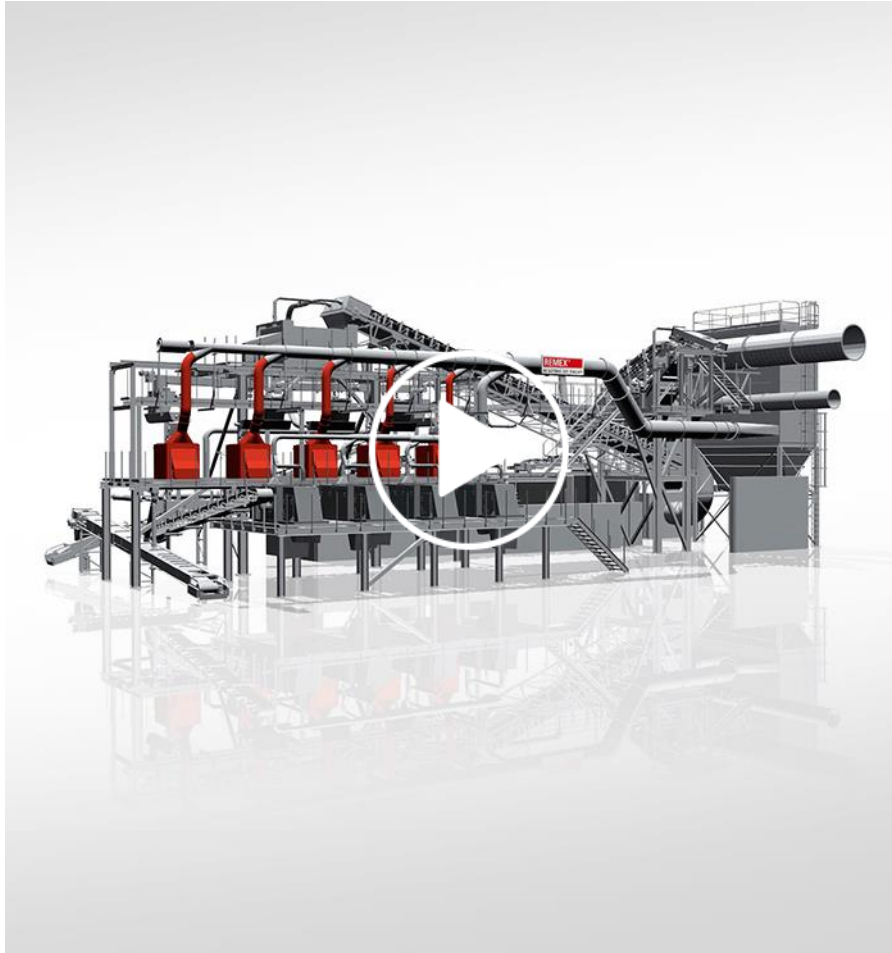
- MERIT® stands for the optimum recovery of non-ferrous (NF) metals from incinerator bottom ash (IBA).
- Our solution focuses on the smaller fraction of NF metals often overseen by other recycling companies.
- The technology has been developed internally and is currently being patented.
- Our technical innovation is based on a ballistic separation principle. A controlled air stream is used to intelligently remove the disruptive fine fraction of ash without removing the inherent valuable metals during the process.

REMEX Processing MERIT® for higher metal recovery



- High potential: on average incinerator bottom ash contains around 2% by mass of NF metals.
- Around a quarter of these metals are smaller than 4 mm. In conventional processing plants these metal pieces are not recovered because the necessary technology is missing.
- MERIT® optimizes the fraction range 2 - 4 mm, which represents 15% of non-ferrous metals.
- REMEX not only applies MERIT® in its own plants but also offers it as an individual module to the IBA processing industry.
- Recycling companies can choose from different cooperation models.

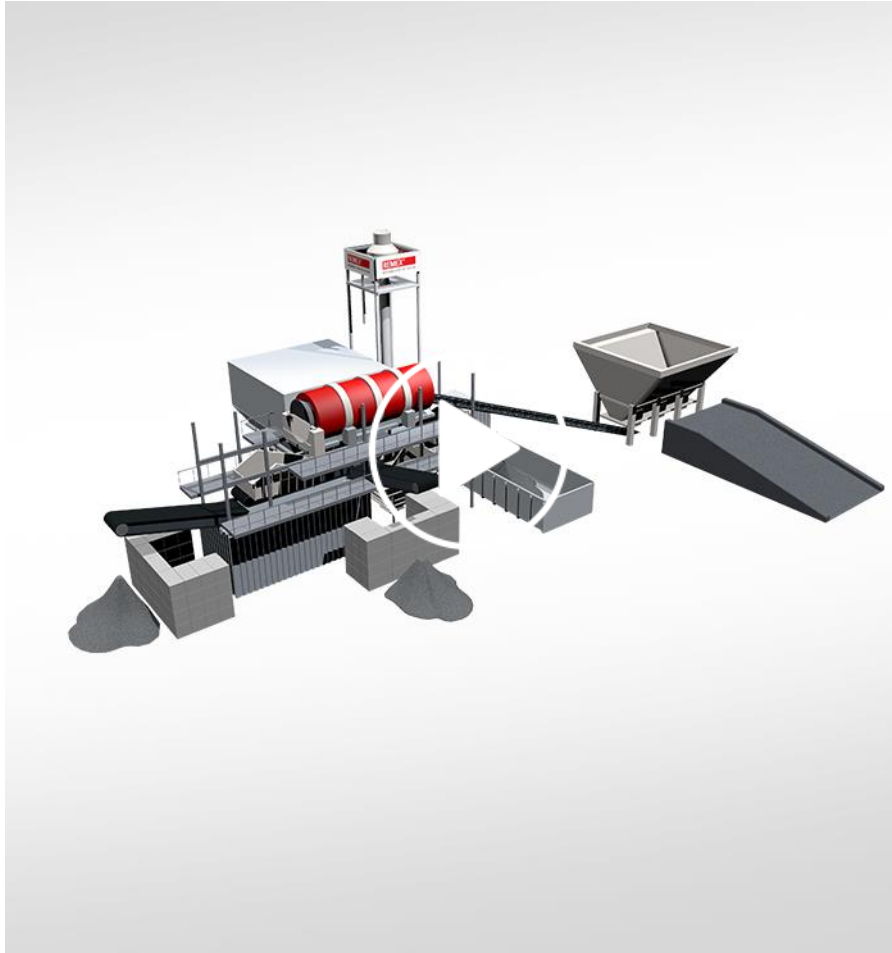
REMEX Processing Non-Ferro Upgrade Facility



- Non-ferrous metals from IBA processing have to be cleansed from adhesive mineral ash and sorted in order to be fit for use.
- To achieve this, the metals are treated in a dry process in our Non-Ferrous Upgrade Facility in the Netherlands where the NF metals are passed over several air tables.
- A combination of sieving, air stream and movement separates the metals into light and heavy metals.
- The result are high purity metal fractions, which can be directly used at the smelting plant.

REMEX Processing

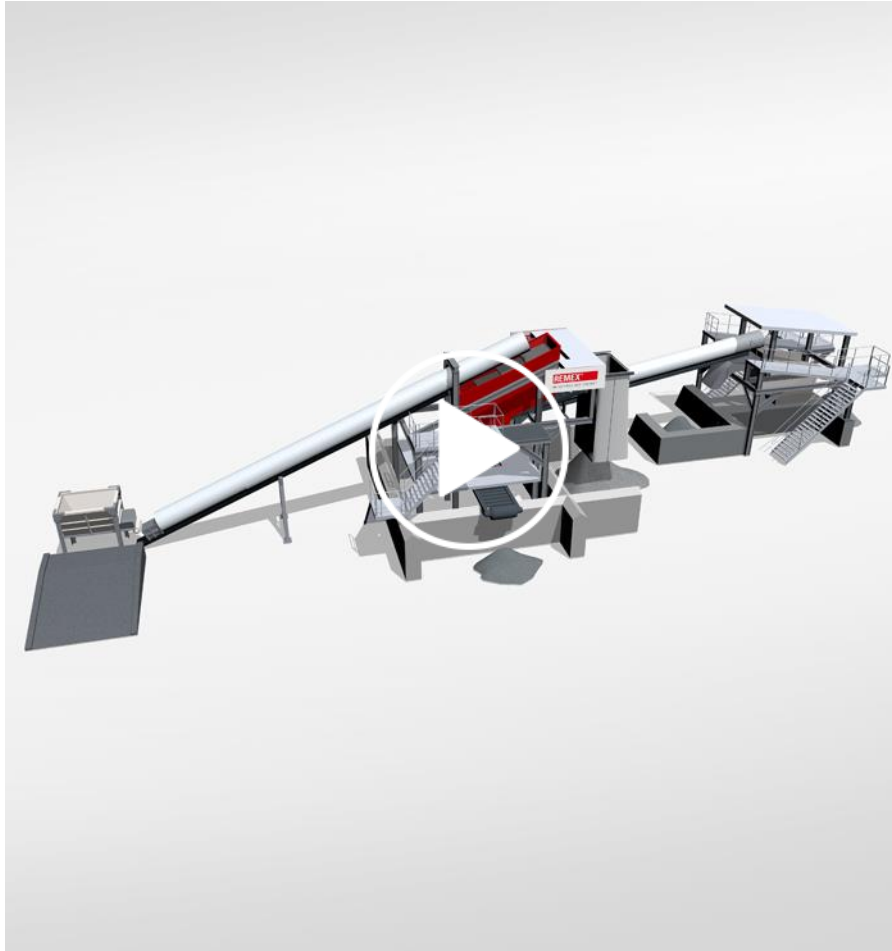
HMT Hydro-Mechanical Treatment



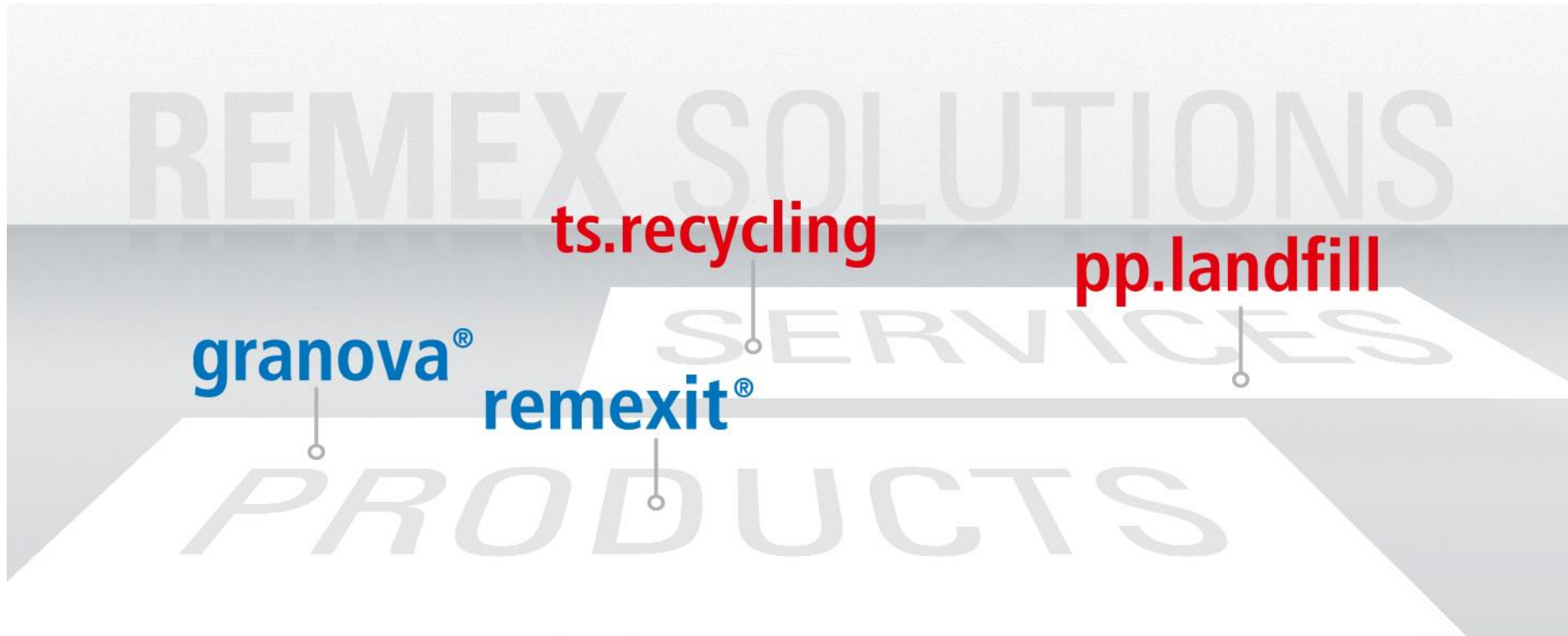
- The combined washing and crushing facility removes sludge and light organic components, verifiably enhancing the environmental quality of the IBA aggregate.
- Special features of the HMT technology at our HEROS plant:
 - Two wash processes
 - Use of an additive
 - Water treatment and recycling
 - Capacity of 300,000 tonnes
 - Production of granova® combimix for use in concrete and asphalt

REMEX Processing

TRIPLE M sieving technology



- TRIPLE M is a 3D sieving technology for incinerator bottom ash aggregates.
- After the main treatment IBA material sized 2 to 12 mm is passed over a special sieve construction.
- Magnetic and eddy-current separators remove any further ferrous and non-ferrous metals.
- TRIPLE M improves the technical construction properties of IBA.
- Result is granova® granulate for use in concrete.



REMEX Solutions
Special products and services

REMEX Solutions

Sustainable aggregates and waste concepts



- REMEX Solutions are our innovative waste management and recycling solutions for manufacturing companies, construction sector and waste management industry.
- REMEX Solutions are exclusively marketed by REMEX and its subsidiaries and holdings.
- Our branded secondary aggregates granova® and remexit® as well as our service models 'ts.recycling' and 'pp.landfill' are part of this portfolio.

REMEX Solutions

Special products and services



REMEX Solutions

‘pp.landfill’ creates landfill space



- ‘pp.landfill’ is a cooperation model between REMEX and the public waste management industry.
- We accept the costs and financial risks associated with construction, operation, closure and aftercare of a landfill. At the same time, REMEX is granted contractually regulated market rights, e.g. for selling part of the landfill volume or recovered metals.
- The public authority remains the legally responsible landfill operator, while reducing its economic risk to a minimum. This ensures sufficient landfill capacities, high recycling rates and stable disposal fees.

REMEX Solutions

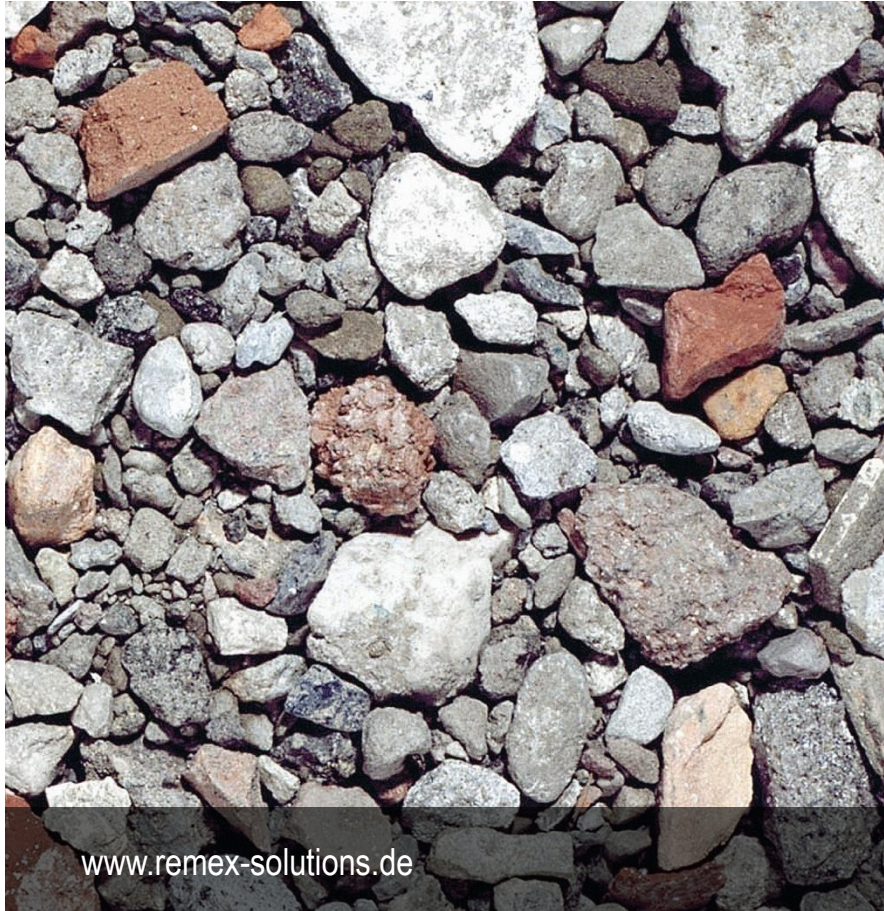
‘ts.recycling’ for tar contaminated road rubble



- Road rubble and stratification material can be contaminated with tar, which is carcinogenic and thus harmful to human health.
- Dependent on the contamination level, road rubble can partly be re-used in bound road construction. However, this method of handling such material is often prohibited.
- Our service concept ‘ts.recycling’ provides the most economic and ecological solution for handling tar contaminated material. This includes the conventional methods of disposal, the use as construction material for landfill sites as well as the possibility of thermal treatment.

REMEX Solutions

Recycled aggregates remexit®



- REMEX processes construction and demolition waste (CDM waste) into a high quality recycled aggregate. The process includes controlled material input and subsequent processing by crushing, sieving and removing metals.
- Our recycled aggregate is mostly used as construction material in the technically demanding upper layers of roads.
- remexit® plays an important part in sustainable construction as it helps save valuable natural resources such as sand, gravel and crushed rock.

REMEX Solutions

Recycled aggregates remexit®: source, production, application



Selective dismantling



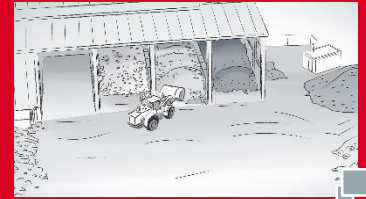
Separated material storage on site



Transport to processing plant



Acceptance and screening at the scale



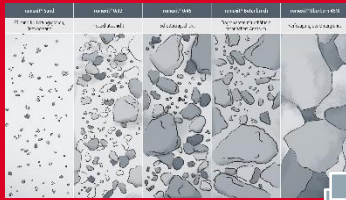
Separate storage of incoming waste



Stationary processing plant



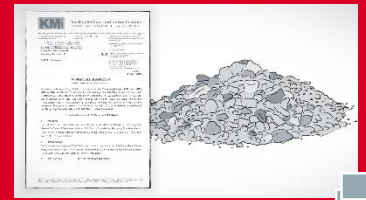
Processing principle



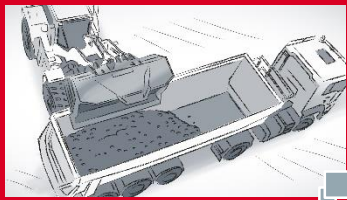
Production of various sieve lines



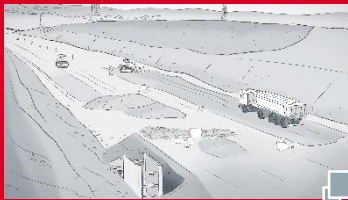
Quality control



Third-party control and certification



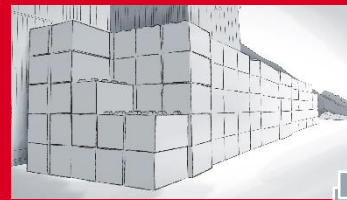
Logistics



Application road construction



Application earthworks

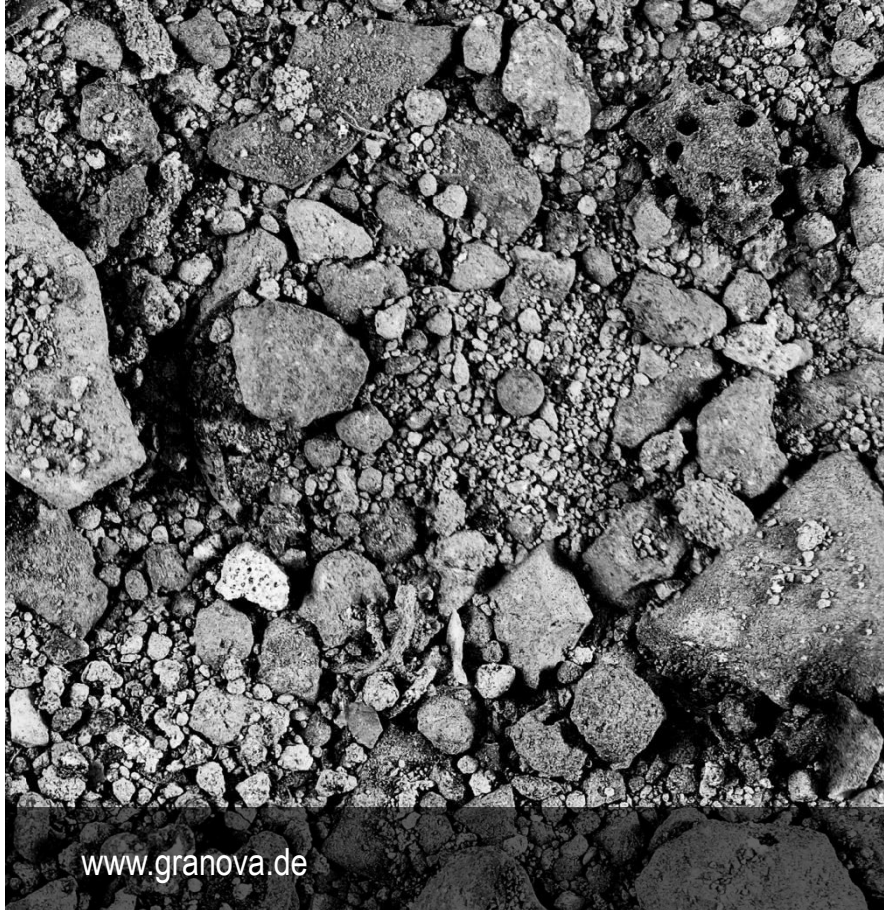


Application concrete



REMEX Solutions

granova® secondary aggregate from IBA



- When municipal waste is burnt in Energy from Waste plants in order to gain energy and reduce the waste volume, bottom ash remains.
- This incinerator bottom ash (IBA) is treated by REMEX and turned into a high quality secondary aggregates using different technologies to separate metals (ferrous and non-ferrous) and remove unburnt material such as organic matter.
- granova® aggregates are used in roads, earthworks or landfill construction. In the Netherlands, we developed granova® granulate and granova® combimix for the use in asphalt and concrete.

REMEX Solutions

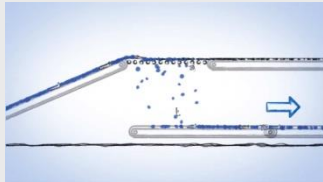
Processing principle granova®



Step 01: The basis for granova® is incinerator bottom ash (IBA)



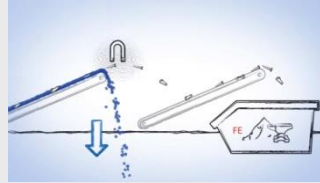
Step 02: Removal of oversized particles



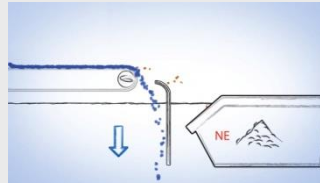
Step 03: Optimised screening and separation with various types of sieves



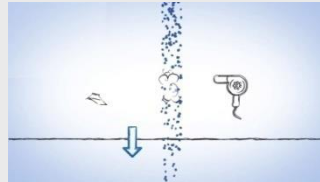
Step 04: Mixed materials and metal pieces are removed manually



Step 05: Extraction of ferrous metals with different types of magnets

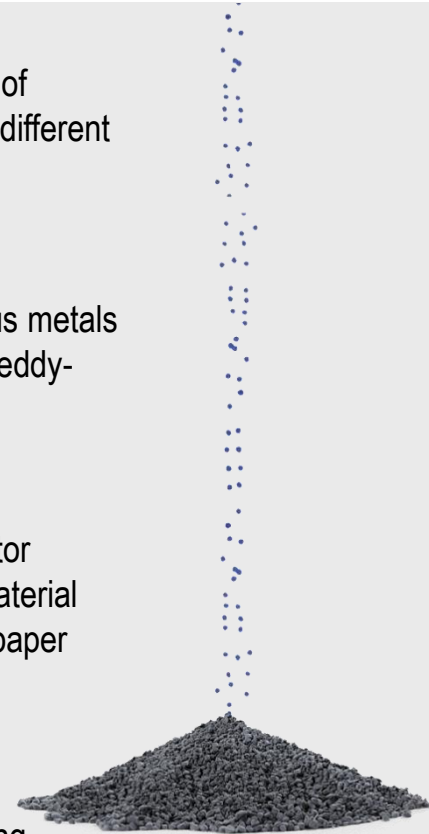


Step 06: Non-ferrous metals are removed using eddy-current separators



Step 07: Air separator removes organic material such as wood and paper

After a corresponding ageing period, the material is ready for use



REMEX Solutions

Processing granova®



REMEX Solutions

Processing granova®

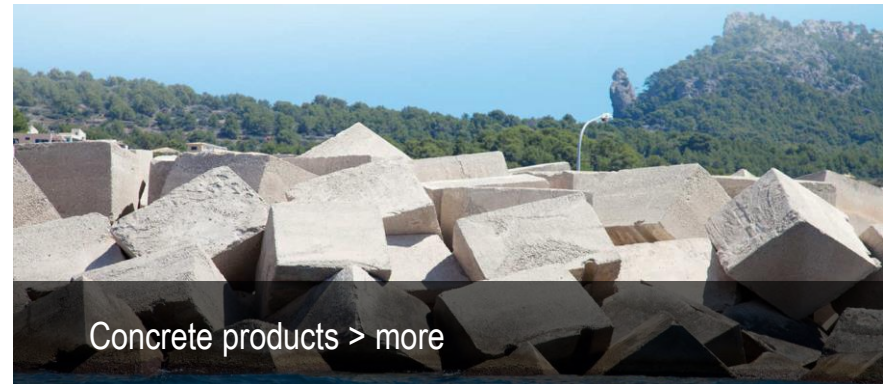
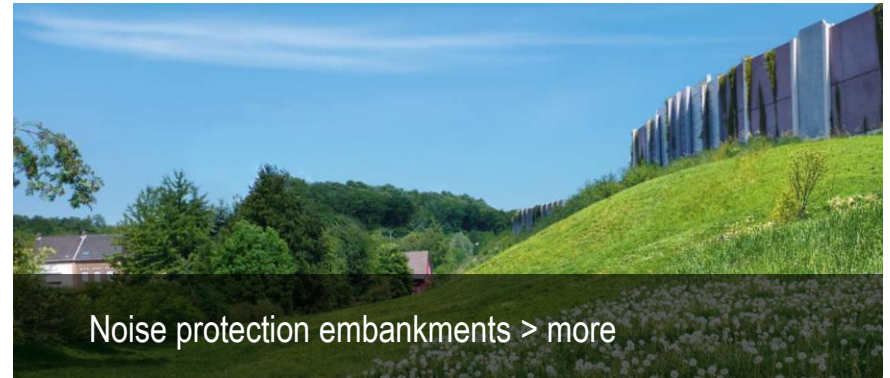


REMEX Solutions Processing granova®



REMEX Solutions

Application areas granova®



granova® Roads and earthworks



Application areas granova®

Reference road construction: L 585n near Münster



- Construction of the L 585n
- Project owner: Straßen.NRW, regional office Münster
- Asphalt construction, exposure class III
- Use of secondary aggregates in defined sections
- 103,000 tonnes of granova® IBAA for the road embankment / subgrade
- Delivery between May 2013 and August 2014
- Supplier of granova®: MAV GmbH, a REMEX affiliated company

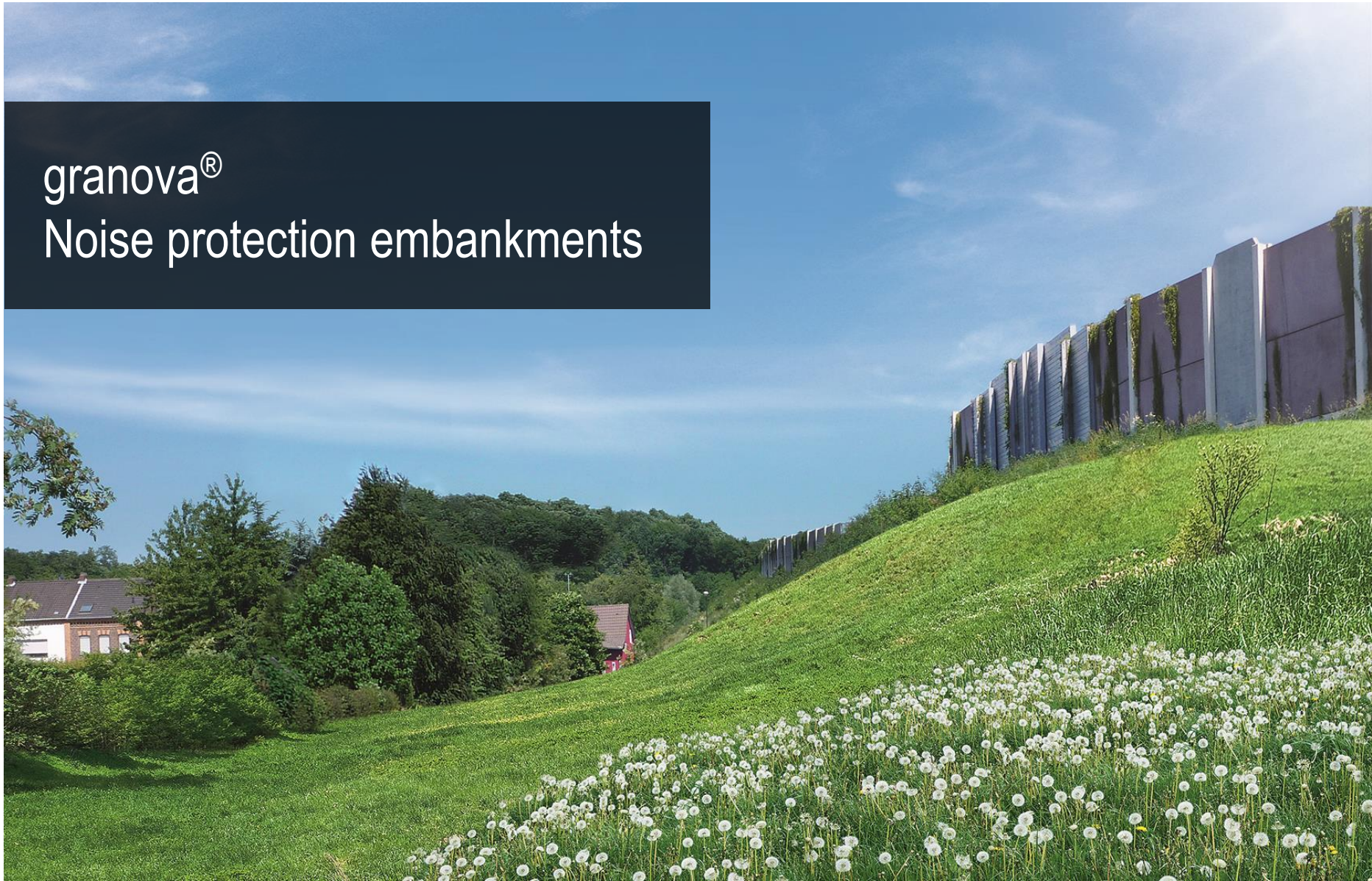
Application areas granova®

Reference road construction: A 61 near Venlo



- New construction of the A 61 between Venlo, Netherlands and Kaldenkirchen, Germany.
- Project owner: North Rhine-Westphalian State Office for Road Construction (Straßen.NRW)
- Two lanes over 3 km under asphalt pavement
- Traffic exposure class SV (motorway)
- Use of 250,000 tonnes of IBAA as fill in the subgrade, provided by a supplier consortium
- Delivery of 145,000 tonnes of IBAA in granova® quality (6,000 tonnes per day at peak times)

granova® Noise protection embankments



Application areas granova®

Reference noise protection embankment: A 44 near Kassel



- Two embankments along the Autobahn A 44, junction Kassel-Wilhelmshöhe
- Owner of the project: Environmental and Parks Department of the city of Kassel
- Contractor consortium consisting of:
 - BAUREKA Baustoff-Recycling GmbH, a REMEX affiliated company
 - EUROVIA Teerbau GmbH
 - Heinz Schnittger Transporte GmbH

| Embankment | Kassel-Oberzwehren | Kassel-Nordshausen |
|------------------------|--|--|
| Construction period: | 4.5 years | > 8 years |
| Completion: | 2008 | expected 2018 |
| Length: | 650 m | 650 m |
| Width: | 40 m | 150 m |
| Height: | 16 m | 25 m |
| Replacement materials: | 900,000 t (= approx. 450,000 m ³) | 1,400,000 t (= approx. 700,000 m ³) |

Application areas granova®

Referenz earthworks: Stabilisation of the Bottrop Ski Hall



Stabilization of the slope on which the Bottrop Ski Hall was constructed through an initial backfilling volume of 450,000 m³.

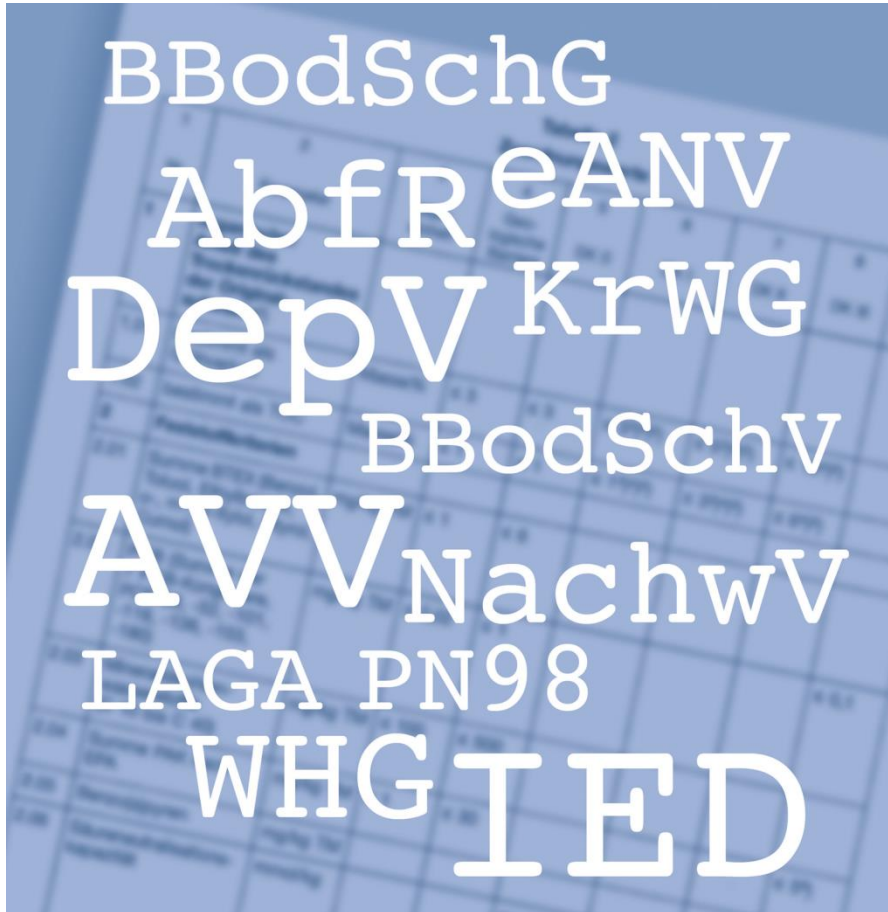
- Combination of granova® IBAA with iron silicate sand, a by-product of AURUBIS copper recycling.
- The material meets the requirements for stability, water permeability and bulk density.
- Since 2016, the structure has been constructed and equipped with safety measures from landfill construction to ensure the long-term stability of the slope and thus of the ski hall.



granova®
Landfill construction

Application areas granova®

Landfill construction



- Landfills are operated within a detailed framework of legal regulations, and safety requirements have increased steadily.
- The construction, operation, closure and aftercare of landfill sites are primarily governed by the European landfill directive, which applies to operators / owners of landfills and long-term storage sites, producers and holders of waste.
- The EU directive and the according national regulations form the basis for the use of IBA as landfill construction material.

granova®
Concrete products



Application areas granova®

Use in concrete in the Netherlands

European standards

Aggregates for concrete

EN 12620

Concrete
(Ready-mix, Pre-Cast)

EN 206
+ National amendments

Concrete products
(Examples)

EN 771-3 Concrete blocks
EN 13383 Armour stones
EN 1338 Paving stones
EN 1339 Paving slabs (<1m)
EN 1340 Road curbs

Dutch regulations

IBA granulate for concrete

CUR aanbeveling 116





Evaluation guidelines for the KOMO®
Product Certificate for IBA granulate as
additive for concrete

BRL 2507



Application areas granova®

Use in concrete in the Netherlands

| EN 1338 | EN 1339 | EN 1340 | EN 771-3 | EN 13383 |
|--|---|--|---|---|
| Concrete paving blocks | Concrete paving flags | Concrete kerb units | Concrete masonry units | Armourstones |
|  |  |  |  |  |

- Applicable are CUR aanbeveling 116 and the associated BRL 2507 for the KOMO certification.
- The use of IBAA is permitted for reinforced and non-reinforced concrete; the use in prestressed applications is excluded.
- Possible is a replacement of natural aggregates of up to 20 Vol.-% in reinforced concrete and up to 50 Vol.-% in non-reinforced concrete and concrete products.

Application areas granova®

Reference concrete: HEROS Sluiskil



- REMEX subsidiary HEROS Sluiskil B.V. is the Dutch market leader for processing bottom ash
- Processing of around 700,000 tonnes of IBA per year
- Introduction of IBAA in granova® quality for use in concrete in 2013



Application areas granova®

Reference concrete: HEROS Sluiskil

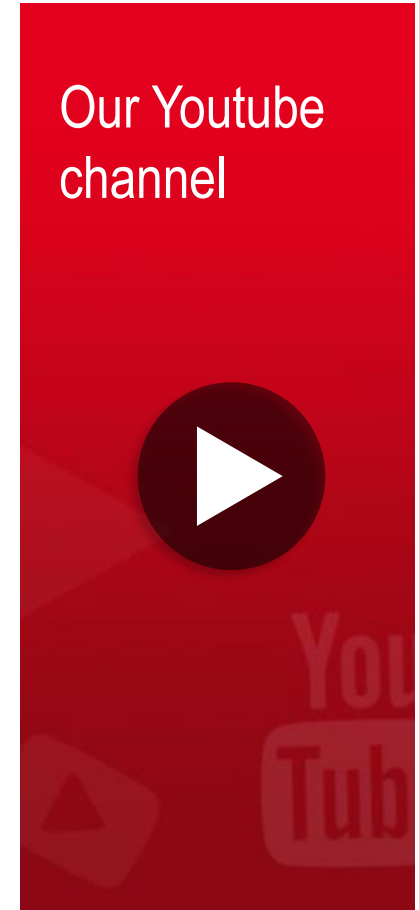


- granova® IBAA quality fulfils high demands for concrete aggregates
- granova® is produced in accordance with EU regulation, the Dutch guideline CUR aanbeveling 116 and BRL 2507
- granova® suitability for concrete is demonstrated with a CE marking and KOMO® certificate

The image shows two documents related to the granova® concrete aggregates. The top document is a CE marking certificate (CE) issued by REMEX, dated 13 juni 2013, for the product granova® IBAA quality. The bottom document is a KOMO certificate (KOMO) issued by KOMO, dated 13 juni 2013, for the product granova® IBAA quality. Both documents include technical specifications and test results for the concrete aggregates.

REMEX Group

Our videos and films



Thank you very much for your attention.