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VacuDry® - the worldwide leading solution to recover resources from industrial waste

Agenda

Agenda for today Chlorosur technical Seminar

Remediation of mercury sludge and contaminated soil

Stabilisation of Mercury → HgS

Market position

Worldwide leading solutions to recover valuable resources from hazardous wastes and contaminated soils

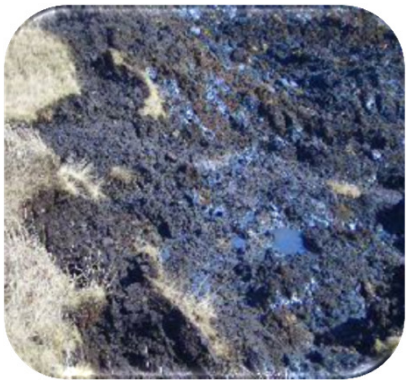
- econ's proprietary VacuDry® technology uses low heat and vacuum for safe and efficient separation of resources like mercury and hydrocarbons as well as other evaporable contaminants
- econ´s technology is flexible to deal with all typical industrial waste consistencies such as crushed building rubble, soils, landfilled residues, lagoon sediments, sludge, filter & centrifuge cake, spent catalyst, spent active carbon, powder, etc.
- econ´s scope of supply and services includes VacuDry® equipment manufacturing, commissioning and operator training as well as rental solutions and joint operations
- oil&gas industry, metal industry, chlorine industry, chemical sites clean-up

VacuDry® input consistencies

Mercury containing wastes and soils

Drill cuttings, refinery wastes, tank bottoms

Grinding swarf and mill scale sludge



Hydrocarbon contaminated soils

Oil lagoon sludge and sediments

other hazardous wastes

'econ´s technology is flexible and considers typical variations of wastes'

VacuDry® applications

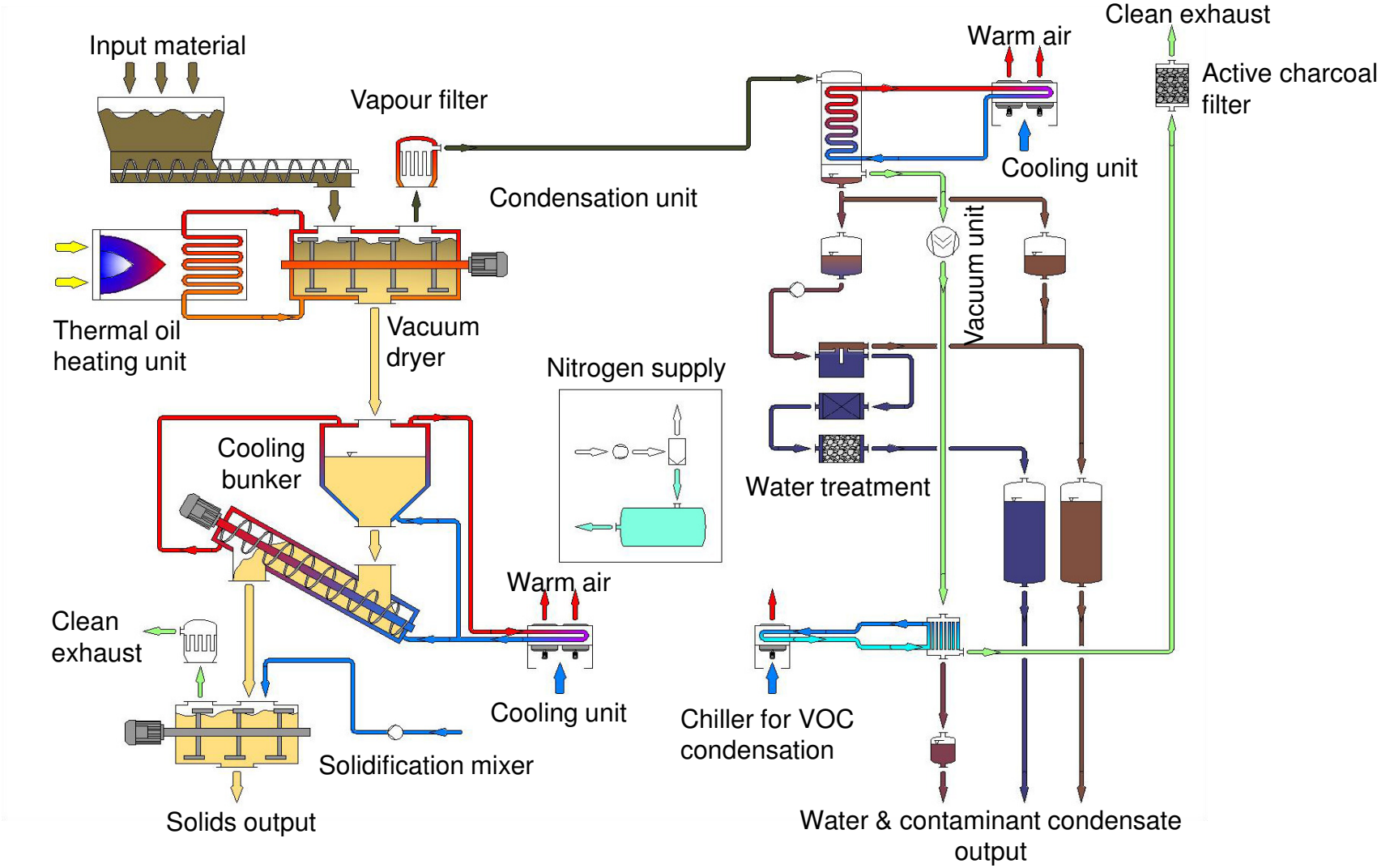
Substances suitable for vacuum distillation by VacuDry®:

- Mercury
- Hydrocarbons (drilling fluids, crude oil, refinery products)
- PAH – polycyclic aromatic hydrocarbons
- POP – persistent organic pollutants (PCB - polycyclic biphenyls; various pesticides, herbicides and fungicides)
- CHC – chlorinated hydrocarbons
- Organic lead compounds

separated contaminants must have a boiling point < 450 °C

'econ´s technology is flexible to separate numerous contaminants'

VacuDry® working principle



Advantages of VacuDry®

- Min. 4 x higher energy efficiency compared to other desorber types (e.g. rotary kilns)
- Lowest process emissions below 1,000 m^3/h due to vacuum operation
- Worldwide EPA acceptance guaranteed, even in neightbourhood to residential areas
- > 99 % resource recovery of mercury, hydrocarbons, etc.
- Only desorber type for hydrocarbons up to C 40 and mercury separation with ATEX (explosion protection) certificate, approved by German TÜV
- Batch wise operation with full process control

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Result of mercury waste treatment with VacuDry® technology:

Purity of mercury: 99,99 %

Cleanliness of solids: up to 1ppm
Sludge: up to 5 ppm

Mobile and stationary equipment available

Mercury contaminated site

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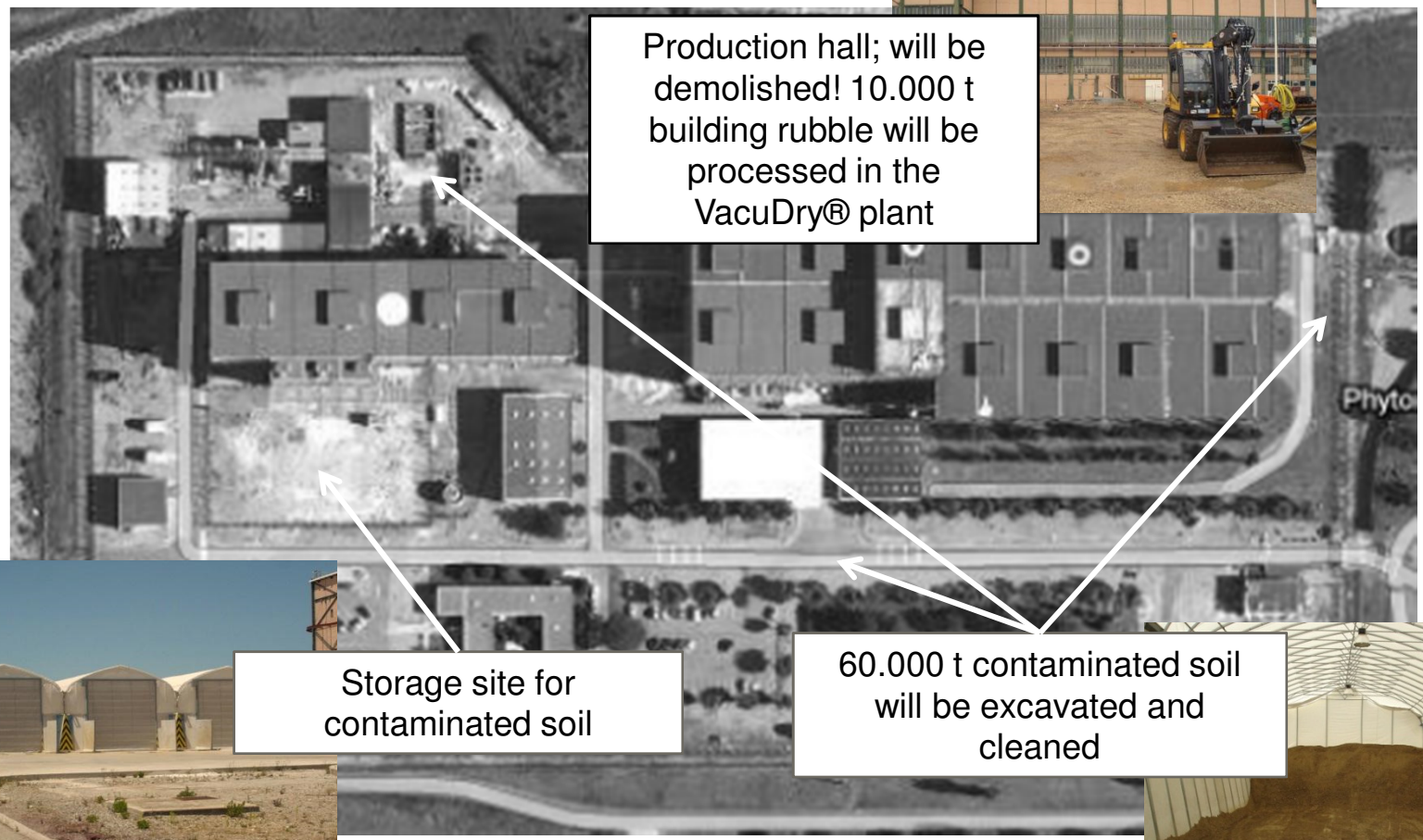

Production hall; will be demolished! 10.000 t building rubble will be processed in the VacuDry® plant

Storage site for contaminated soil

60.000 t contaminated soil will be excavated and cleaned

VacuDry® for contaminated soil

Feeding material:	Soil, building rubble, filter cake soil washing
Contamination:	Mercury, PAH and others
Plant design:	Stationary. modular
Feed material consistency:	10 to 50 % moisture
Feeding system:	Belt conveyor
Equipment:	2 x VacuDry®12,000 Remoistening and solidification mixer SolidMix 1,500
Indirect heating:	400 °C / thermal oil
Throughput capacity:	4 t/h
Start up:	2011

Mercury contaminated soil

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Stabilization of mercury Hg → HgS

At the customer premises

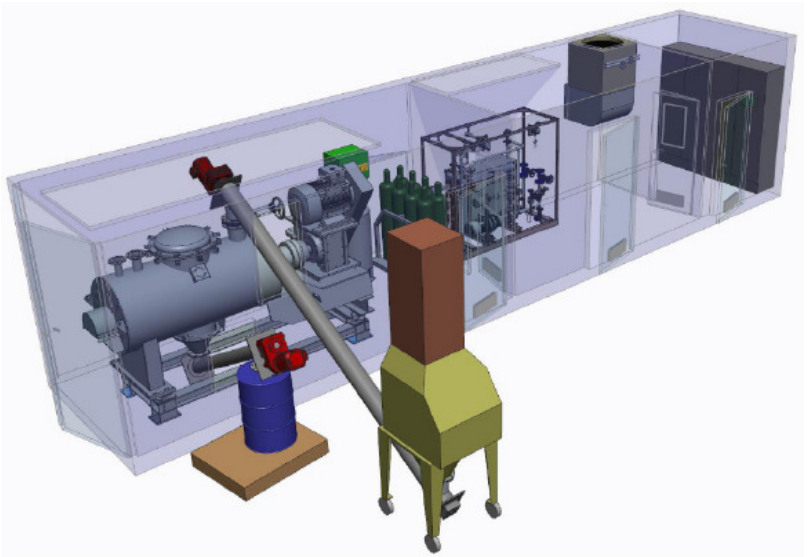
Provided as a service

On-site Mercury Stabilisation

The most economical solution for the chlorine-alkaline industry to transform metallic mercury to mercury sulphide

Metallic mercury

Sulphur



Containerised unit for on-site mercury stabilisation

Red mercury sulphide

On-site Mercury Stabilisation

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Market environment

- EU regulation EC 1102/2008 → export ban requires safe storage of metallic mercury
- Euro Chlor voluntary agreement → phasing out mercury cell technology by 2017
- Stabilisation of metallic mercury to mercury sulphide → currently best available technology for final disposal
- Partial unsound mercury waste processing methods → increased demand for 100 % traceability of the disposal procedures

Legal compliance

Technical reliability

Lowest price

Highest throughput

On-site Mercury Stabilisation

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Legal compliance

- one single on-site process step resulting in non-hazardous material
- 100 % traceability from cradle to grave guaranteed
- `disappearance´ of metallic mercury impossible
- third party supervision by certifying body welcome

Lowest price

- fair, comprehensible pricing: equipment rental fee PLUS incentive for throughput
- on-site utilities and energy provided by customer at real costs
- the shortest way to final disposal: no overheads for involvement of waste management company
- no trans boundary movement of hazardous goods, no interim transport, no certified containers, no transport notification necessary

On-site Mercury Stabilisation

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Technical reliability

- easy-to-handle, safe and fully capsuled process design
- machinery design experience from over 20 years operation with mercury waste
- experience in implementing hazardous waste solutions in cooperation with international EPAs in more than 15 countries
- total project management by highly-skilled team of engineers incl. on-site servicing

Highest throughput

- process design for 6 tons per day in 3-shift operation
- largest existing mercury stabilisation mixer
- duplication of throughput to 12 tons per day possible with parallel on-site operation of 2 mobile units

On-site Mercury Stabilisation

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How to generate red mercury sulphide:

Liquid mercury and sulphur powder react spontaneously and intensively in a safe and hermetically closed reactor:

- Stoichiometric reaction of mercury and sulphur
- Continuous, intensive mixing during the process to fully convert the reactants
- Permanent mechanical crushing of sulphur and mercury sulphide particles
- Semi-automated processing with automated dosing of mercury over a fixed time period
- Continuous temperature control

On-site Mercury Stabilisation

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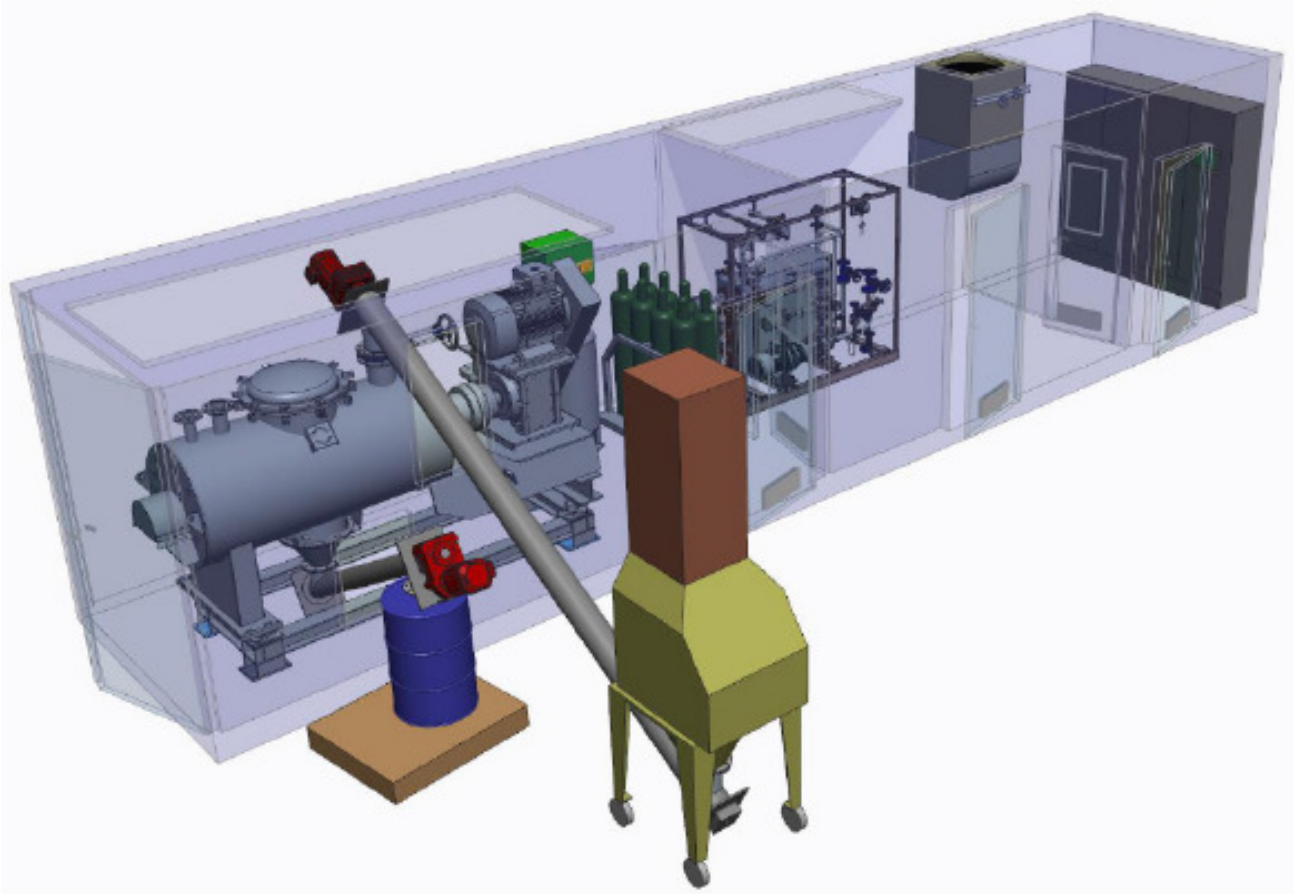
Layout



On-site Mercury Stabilisation

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The process steps

Step 1: Feeding

1. 2 tons of mercury[*1] are sucked directly out of the customers container into the feeder tank (V10.1) of the mobile plant
2. the mixer is evacuated and then inerted by venting with nitrogen 3 times
3. 320 kg of sulphur[*1] are filled into the mixer by the feeding screw (C10.1)

Step 2: Stabilization process

1. the mixer shaft starts rotating
2. the continuous injection (3-4 hours) of mercury is started
3. after a certain time of mixing the stabilization is completed

Step 3: Quality check and discharge

1. the mixer is cooled down to < 60 °C
2. a sample is taken and measured for any remaining mercury vapour
3. the produced HgS is emptied via the discharge screw (C30.1) directly into barrels

[*1] the feeder tank and the mixer are equipped with weighting cells

On-site Mercury Stabilisation

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Emissions

Basically:

- The chemical reaction of the two elements mercury and sulphur to mercury sulphide generates no gaseous emissions respectively no off-gas flow
- The process is conducted in a gas tight and cooled system under ambient pressure
- The only and very small off gas volume is generated by the pump which is only operated during the preparation of the plant before the process starts
- No mercury emission into the air

On-site Mercury Stabilisation

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Safety at work

- no direct handling of mercury
- operated in a closed system
- daily Hg-measurement inside the container
- CE marking / EC declaration of conformity
- certified by TÜV-Süd Germany

On-site Mercury Stabilisation

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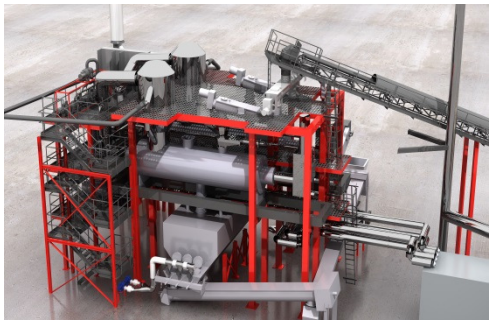
Provided by econ industries:

- 20 years mercury waste handling experience
- Supply of equipment in containerised execution
- Transport organisation for equipment and parts
- Supervision and training for on-site operation
- Project management inside econ´s office and on-site
- Consultancy on final disposal options for mercury sulphide
- Technical documents for local approval procedure
- Supply of health & safety guidelines
- Technical clarification with local authorities
- Presence of engineers at technical meetings
- Supply of wear and spare parts
- Process warranty for final treatment results



3D equipment design

`econeers´ working with NORM

econ industries provides the most efficient and cleanest solutions to process special wastes worldwide!

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