Mineral Wool from THERMOSELECT Processes

The THERMOSELECT process accepts and efficiently processes commingle solid waste streams which can include municipal waste, commercial waste, refuse derived fuels (RDF), Automotive Shredder Residues and industrial waste.

THERMOSELECT

- Operates without venting dust, odours or process gases into the environment
- Generates no bottom or fly ash
- Recovers and reuses all process water
- Recovers usable products from waste
    - Energy rich synthesis gas for chemical down-stream production or electricity generation
    - Glass-like mineral melt for Mineral Wool production
    - Metal granulates

A typical Mass Balance resulting from Municipal Solid Waste Feedstock (MSW) is shown in Fig. 1.

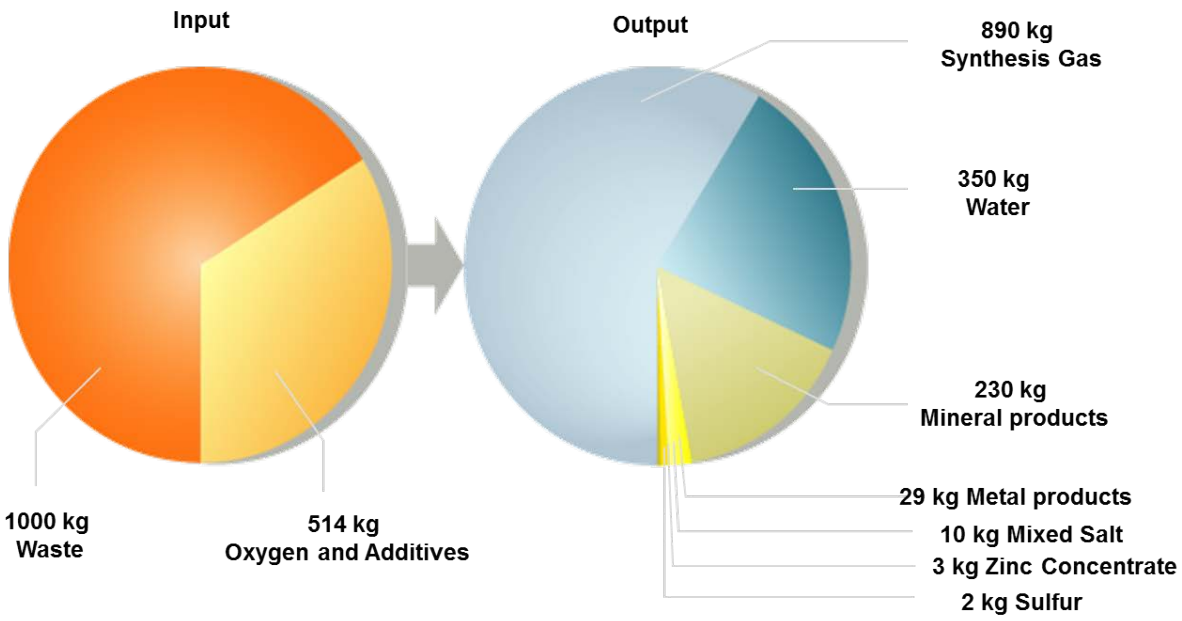


Fig. 1: THERMOSELECT Mass balance (typical for MSW)

Inorganic Products

The waste feedstock composition has impact on quantity and quality of all resulting products:

100'000 tons of waste feedstock contains about 20'000 – 25'000 tons of minerals and metals (25%). The portion of the metals commonly is discovered at 1% - 5%.

The inorganic portions of the waste, including scrap metals and glass, become molten in the lower section of the THERMOSELECT high temperature reactor which reaches temperatures in excess of 1'800^{o} C.

The inorganic melt flows in a homogenization reactor where mineral and metal components separate due to different densities. The specific weight of the mineral melt is about 2,8 t/m^{3}.

As the metal melt mainly consists of iron, a density of about 8,0 t/m^3 can be assumed. The metal melt sediments to the bottom, the mineral melt flows above.

In the homogenization reactor the melt is purified thermally. The burners are operated under excess oxygen conditions to combust carbon particulate matter.

The molten inorganic melt allows the recovery of clean metal alloy, free of contamination and ready for reuse after granulation in a water basin. The metal product is dominated by its high iron content. The alloy includes copper, small amounts of nickel, chrome and zinc or similar.

The main portion of the inorganic material forms a glass-like mineral product that is non-toxic, inert and usable in many ways. The chemical composition differs in dependence of the feedstock characteristics. An example is shown in Fig. 2.

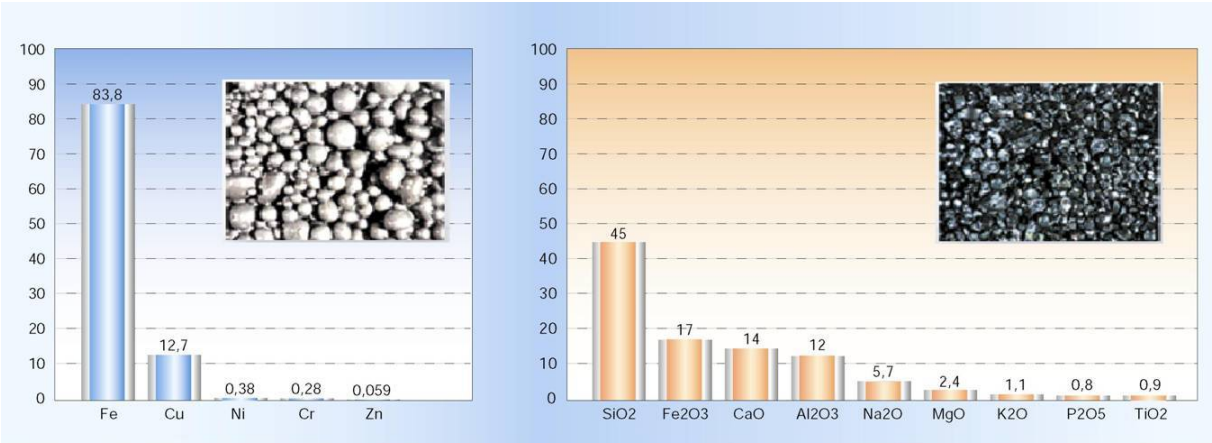


Fig. 2: Typical Metal and Mineral Composition

The chemical composition of the mineral product is comparable to Basalt stone (vulcanite Magma), the main components to be SiO_2, FeO, CaO, Al_2O_3, and Na_2O.

Mineral Wool Manufacturing

Mineral Wool is a soft material produced from mineral fibers. Depending on the primary material, you distinguish between Glass Wool and Stone Wool. THERMOSELECT homogenized mineral melt shows a similar composition as the natural stone basalt:

	THERMOSELECT sample 15.5.91 mass %	Basaltlava Vordereifel 1) mass %	Basalt Standard 23955/03 2) mass %
SiO2	**47.1**	**45**	**49.5**
Al2O3	**8.3**	**18**	**16.2**
Fe as Fe2O3	**10.1**	**11**	**9.7**
CaO	**12.9**	**9.6**	**6.5**
K2O	**1.4**	**5.2**	**0.2**
Na2O	**2.6**	**3.2**	**4.6**
MgO	**3.2**	**6.7**	**7.5**
MnO	**0.7**	**0.1**	**0.1**
TiO2	**0.8**	**0**	**1.14**

1) Zentralinstitut für Festkörperphysik und Werkstofforschung, Dresden 11.7.1991

2) TGL 23955/03 Geological Industry, Rock standard samples Basalt BM
Zentrales Geologisches Institut, Berlin 21.10.75

Stone wool fibers microscope

Mineral wool

In conventional Mineral Wool manufacturing, the primary material becomes melted at temperatures between 1'200° C and 1'600° C. For stone wool, rocks like Basalt, Feldspar, Dolomite or similar are applied. The rocks mainly originate from stone quarries. Such intervention in the nature puts a strain on the climate balance of stone wool.

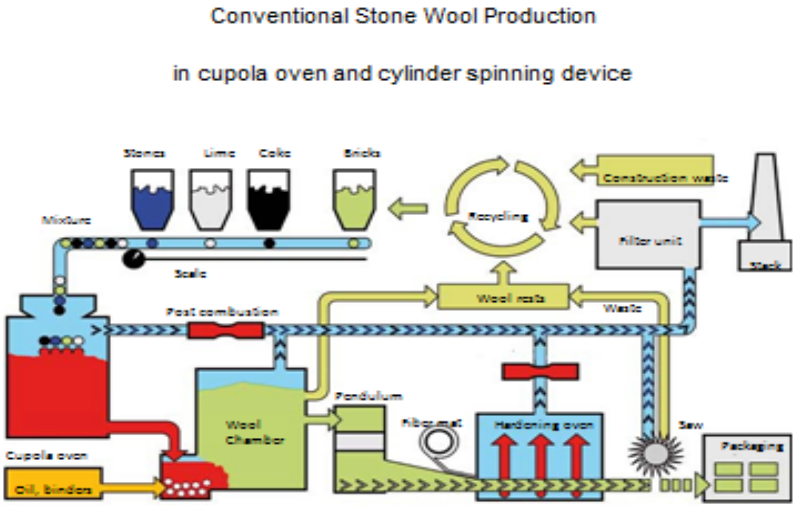


Fig. 3: Adopted from BBSR-Berichte KOMPAKT, Künstliche Mineralfaserdämmstoffe 1/2011, Bundesinstitut für Bau-, Stadt- und Raumforschung im Bundesamt für Bauwesen und Raumordnung

Melting of rocks requires a high amount of energy between 150 – 400 kWh/m^3. (Other insulation, like rigid foam from Polystyrol needs even more: 450 – 1'000 kWh/m^3.)

The Basalt-like inorganics from the THERMOSELECT processes already occur in the liquid form at the required temperature level of about 1'600° C. The homogenized melt is immediately available for fiber production – without the need of above shown energy for melting of natural stones.

The hot melt – be it from natural stones or originating from THERMOSELECT – is directed via a buffer tank (oven) to a fiber spinning device. In the THERMOSELECT system, the heated buffer tank takes care of feedstock variations in quantity and composition.

Components like MgO, AlO or reductive material can be supplemented in order to ensure the desired fiber product quality. Drop by drop the melt strikes a fast rotating centrifuge. Similar to cotton candy on a fair, fibers are expelled by rotation of the disc.

Fiber spinning

Fiber production by a horizontal, fast rotating disc was patented in 1931 (No. 539738 Reichspatentamt Germany).

Mineral Wool production from natural stones as well as from hot inorganic melt is proven technology. Mineral wool technology for THERMOSELECT plants is provided by ADVANTECH (www.advan-tech.net), a company with vast experience in stone and glass wool manufacturing.

DEUTSCHES REICH

Bibliotheek

AUSGEGEBEN AM
19. FEBRUAR 1932

REICHSPATENTAMT

PATENTSCHRIFT

№ 539 738

KLASSE 32a GRUPPE 24

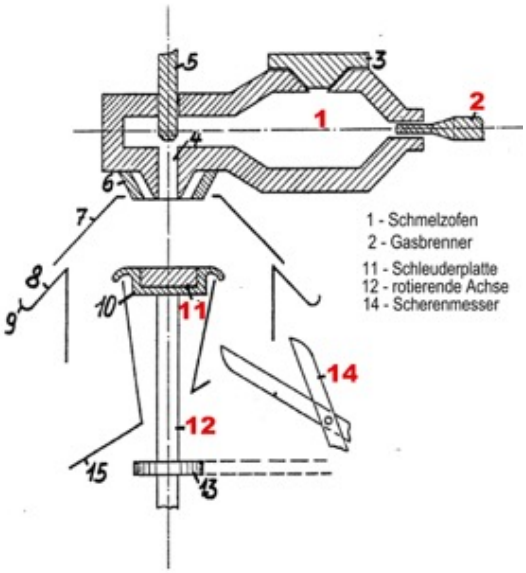
32a R 235. 30

Tag der Bekanntmachung über die Erteilung des Patents: 26. November 1931

Naamlooze Vennootschap Maatschappij tot Beheer en Exploitatie van Octrooien in Den Haag

Verfahren zum Herstellen von Fasern oder Gespinst aus Glas, Schlacke und ähnlichen in der Hitze plastischen Stöffen

Patentiert im Deutschen Reiche vom 30. November 1930 ab



Depending on the final product choice, 0,5% – 7% phenolic resin for stabilization and 0,5% mineral oil for dust binding are added. Like that, a fiber fleece forms. For hardening it is forwarded by a chain belt through a heated (about 230° C) oven. As the wool moves through the curing oven, it is compressed by varying the aperture of the oven. This controls the density, and hence the rigidity and structural strength, of the end-product. The curing oven heat sets the resin binder.

Fiber fleece

After the curing oven, facings such as aluminum foil or scrims can be applied to the surface of the stone wool according to product applications and/or customer requirements.
Blankets are cut into the desired dimensions.

Mineral wool fleece faced with aluminum foil

Mineral wool flocs

Mineral Wool Properties

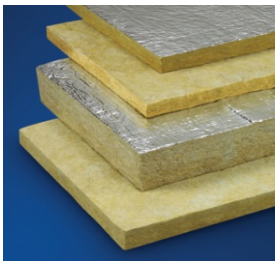
- Mineral Wool is the most applied insulating material in the construction industry. It combines good thermal insulation effects with high noise protection, and is non-combustible class A 1.
- Mineral Wool used for thermal insulation is subject to the European Norm DIN EN 13162, Directive 89/106/CEE (thermal insulating material for buildings – factory made products from Mineral Wool).
- The thermal conductivity of Mineral Wool is low. The insulation effect results from the inclusion of air in the interspaces between the fibers.

- Mineral Wool proves a high heat resistance and is used as fire prevention.
- Stone Wool has a high acoustic isolating potential. Therefore it is a desired material for noise protection in ceilings.
- Under oxidizing conditions, Stone Wool proves high thermic stability. Under reductive conditions it sinters at about 800^{o} C.
- Stone Wool is bio-soluble in human lung and thus no health risk. Occupational health and safety aspects are respected during the manufacturing process.
- Glass Wool can be compressed – Stone Wool not or little. Isolating tiles from Stone Wool are more bearing, but less flexible.
- Stone Wool shows densities from 22 - 200 kg/m^3. The density has influence on own weight of construction (roof, wall) and temperature protection. Utilization purposes define product density.
- Mineral Wool is resistant against fungi, putridity, and bugs.
- Modern plant growing replaces natural soil by basalt fiber blankets or cubes in professional green-house applications for industrialized planting of vegetables, fruits and flowers. The fibers improve root growing, thus the plants can absorb more nutrients.

THERMOSELECT Mineral Wool Specification and Applications

THERMOSELECT produces a complete family of insulating products, according to norm EN 13162 Directive 89/106/CEE. They show high performances in thermal insulation, fire prevention and sound protection.






PRODUCT TYPES

- ✓ **Loose “white” wool**
  without binder, for direct wall cavities filling

- ✓ **Matting with different facing**
  rolls and slabs, without facing or with paper, aluminum, glass tissue facings

- ✓ **Insulation pipes**
  for civil buildings, industrial plants and equipment

- ✓ **Hydroponic mineral wool cubes**
  replacement of soil in modern agriculture of vegetables, fruits and flowers

- ✓ **Special products**
  for automotive and home appliances insulation, large blocks for special shapes cutting, special insulation for industrial, Oil&Gas and energy plants

Standard dimensions (maximum sizes for standard products)

- **rolls** 1200mm x 14000mm, thickness 10mm to 150mm
- **slabs** 2400mm x 6000mmm, thickness 20mm to 300mm
- **pipes** length 1500 mm, diameter any under 1.200mm, thickness 20mm to max diameter
- **blocks** 2000mm x 1200mm x 3000mm
- Other dimensions by specific equipment design

PRODUCT TECHNICAL SPECIFICATIONS

Conformity to standard	EN 13162
Filament structure	mineral fibers, standard or oriented
Density	60 to 200 Kg/mc
Compressive strength	40 to 160 kPa
Service temperature	700°C
Thickness	10 to 300 mm
Heat resistance/internal self-heating at 750°C for 16 hours	no fiber deterioration
Inflammable Property Directives 94/611/CE,96/603/CE, 2000/605/CE	non-combustible class A 1
Thermal conductivity Average temperature 10°, norm UNI 12667:2002	depending on density, from λ = 0.045 W/(mK) to λ = 0.034 W/(mK)
Caloric Specification according to norm EN 12524	1030 J/Kg°K
Water vapor diffusion resistance factor	μ = 1,3

(above specifications can vary depending from the type of product)

Security and health

Mineral Wool from Thermoselect Processes can comply with note “Q” and note "R” of the EU Directive 97/69 CE, and with D.M. 01-09 1998 and later updates.

Mineral Wool Technology

Mineral Wool Technology by Advantech – Advanced Industrial Technologies

Above data, apart from those that are defined in CE, must be considered as guidance. We reserve the right for modifications at any time and without pre-announcement.

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VIVERA CORPORATION

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