OUR RESEARCH FOCUS AREAS

A comprehensive overview of our research focus areas can be found here.

In the research areas of construction materials, environment, transport construction, fertilisers and SEKROH-MET, the focus is on community research, committees and standardisation activities, and services for members and non-members of the FEhS Institute.

CONSTRUCTION MATERIALS:

In the field of construction materials research, the range of services extends from the preparation of theoretical studies, to optimisation investigations for binding agents and concrete in terms of reactivity and durability, to laboratory testing of construction materials and even training courses.
Construction materials such as ground granulated blast furnace slag, and binding agents manufactured from it, are investigated along with their potential applications, as are new utilisation concepts for slag as a binding agent or aggregate.

GROUND GRANULATED BLAST FURNACE SLAG

- We characterise ground granulated blast furnace slag types manufactured around the world.
- We identify correlations between chemical and physical properties and technical performance.
- We work on optimising these properties.
- We develop alternative manufacturing and grinding technologies.

BINDING AGENTS CONTAINING GROUND GRANULATED BLAST FURNACE SLAG

- We research methods for optimising the properties of blast furnace cement, particularly as regards early strength development.
- We work on the development of binding agents free from Portland cement clinker, as an alternative to cement.

CONCRETE

Our research on the subject of durability focuses amongst other points on frost and de-icing salt resistance, carbonation, sulphate resistance at various temperatures, and resistance to damaging alkali-silica reactions.

In addition, we are investigating aggregates made from ferrous slag, e.g. aggregates made from BOF slag or electric arc furnace slag.

FERTILISERS:

In the field of fertilisers, the FEhS Institute develops and optimises processes for manufacturing fertilisers from slag, together with metallurgical measures to ensure environmental safety and expand the potential applications. Opportunities for quality improvement are also researched, e.g. through nutrient enrichment, as is the effect of the slag on soil, plants and groundwater in vegetation testing.

The results of our research appear in publications and lectures on a national and international level. We support our members and customers in the interpretation and preparation of regulations, and consult them on the utilisation of lime fertilisers.

SECONDARY RAW MATERIALS AND SLAG METALLURGY – SEKROHMET:

New production processes and efficient use of resources.

The research focus of the Secondary Raw Materials and Slag Metallurgy (SEKROHMET) department is on optimising slag quality in terms of technical and environmental parameters and the associated processes, starting from the metallurgy. Its continuous aim is to develop new products from slag, and hence to open up new markets. Through the efficient use of resources, this contributes to sustainable and environmentally friendly steel manufacturing.

Alongside slag, secondary raw materials produced in the iron and steel industry, and also the non-ferrous metals industry, include dust, sludge and roll scale. New processes are intended to make optimal use of these raw materials, reclaiming recyclable materials and producing products from the raw materials.

- We investigate opportunities for the metallurgical treatment of slag in order to improve its volume stability, to inhibit its tendency to disaggregate, to improve its environmental safety, and to optimise its physical properties.

- We research reduction processes for reclaiming valuable metals from ferrous slag, and for producing marketable products from the remaining melt.

- We investigate and develop processes with a practical orientation for heat recovery from ferrous slag, with the ambition of (continuing to) generate a marketable product.

- We research options for internal recycling, e.g. the use of dust containing zinc for zinc enrichment and recovery, reduction of landfill requirements for furnace gas and converter sludge, and the replacement of primary limestone with secondary metallurgical slag.

- We investigate options for external use by developing alternative binding agents, thermal treatment processes for product optimisation, and processing substances in external processes to develop new products and fields of application.

- We publish the results of our research in publications and lectures on a national and international level, work in various committees, and provide contract work, basic engineering and consulting services.

ENVIRONMENT:

Testing environmental safety; development and standardisation of leaching processes

The FEhS Institute has been working for many years to ensure compliance with the highest environmental requirements for ferrous slag (FS). Starting with the input materials, metallurgy, pretreatment and application, process optimisation is aimed at throughout, with the objective of manufacturing the best possible FS.

A significant proportion of ferrous slag is used in road construction and path construction, but also in hydraulic engineering. Alongside technical properties, above all it is important here that the effects of the mineral materials on soil and water are taken into consideration, i.e. water resource safety.

In order to obtain realistic results, special features of industrially manufactured mineral materials such as FS must be taken into consideration. The FEhS Institute has therefore been centrally involved for many years in the development and standardisation of leaching processes for FS, on a national and European level. The environmental behaviour of mineral materials is investigated in trial paths built specifically for this purpose, with their special design facilitating the collection of real seepage water.

Another important field of application for industrially manufactured mineral materials is hydraulic engineering (embankments, jetties, bank protections, pools). Practical experiments provide clarity about the leaching behaviour of the mineral materials and their effects on aquatic organisms that prefer to live on the rough surfaces of slag rocks.

- The different types of FS (blast furnace slag, steel slag, secondary metallurgical slag, etc.) are analysed to determine their constituent materials (total content). These results are incorporated into an extensive database, which represents an important basis for discussions about the definition of requirement values.

- We investigate the leaching processes in the event of construction materials coming into contact with water (surface or rainwater). This is done both by means of various laboratory methods and also on a semi-technical (lysimeter) and technical (trial paths) scale.

- Various factors (e.g. grain size distribution, moisture content, duration of storage) that influence leachability are investigated together with a potential correlation between solid material content and leaching rate.

- The results of the environmental safety tests find their way into regulations, standards and legislation. One important subject is, for instance, the registration of FS as "non-hazardous substances" within the meaning of the REACH regulation, which has been and continues to be significantly supported by the FEhS Institute.

- Mineralogical analysis of the bonding structures of slag-type elements, in combination with the leaching tests, deliver important information regarding the environmental behaviour of FS. As a consequence of this, the properties of FS can be improved, e.g. through metallurgical measures or treatment steps.

TRANSPORT CONSTRUCTION:

Retention and expansion of the traditional application areas for FS aggregates

Crystalline ferrous slag (air-cooled blast furnace slag, BOF slag, electric arc furnace slag) is traditionally used in road construction, path-building, earthworks, track-building and hydraulic engineering. The FEhS Institute investigates the potential applications of such lump slag and ground granulated blast furnace slag, both technically and in terms of environmental safety, always with a focus on securing existing application areas and opening up new ones, and always maximising quality while maintaining low costs.

- The cubic grain geometry and rough surface of ferrous slag ensure a high load-bearing capacity during the construction of base courses without binding agents. In the process, construction material mixtures made from ferrous slag are insensitive to fluctuations in water content, which is why they can be installed and immediately driven on, even under unfavourable weather conditions. We support this important application with analyses for the further improvement of the construction materials and for optimising construction methods.

- We investigate alternative potential applications for ground granulated blast furnace slag: traditionally used as a cement ingredient in road surfaces made from concrete, but also as a binding agent component together with activators from industrial processes for hydraulically bound base courses and soil treatments, and finally as a substitute for crushed sand components in asphalt layers.

- Due to the high speeds, rail transportation generates high dynamic loads, which need to be dissipated by the construction materials used. The successful investigation of the use of steel slag in railroad beds has meanwhile been utilised in an expansion of the regulations of the German rail operator Deutsche Bahn.

- Asphalts with steel slag are anti-skidding, deformation-resistant and durable. Furthermore, asphalt layers do not transfer any elements considered critical into the soil and groundwater. We therefore work on many details in order to improve the potential applications of slag materials in asphalt.

- The basis of the use of construction materials in the construction of transport infrastructure is the technical regulations, which today are typically based on European standards. We are intensively involved in the process of developing new regulations and revising existing ones, on both a national and European level.