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FRAUNHOFER PROJECT GROUP MATERIALS RECYCLING AND RESOURCE STRATEGIES IWKS

URBAN MINING

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URBAN MINING

Urban Mining – Goals and challenges

Many inorganic and composite materials end up on landfills but do not belong there! Global industries like the steel, iron and aluminium industry produce millions of tons of different dusts, sludges, ashes and slags on a day-to-day basis.

The department "Urban Mining" of the Fraunhofer Project Group IWKS is specialised in the development of technologies for the effective and sustainable use of resources from waste materials.

In close cooperation with business partners new recycling concepts and future-oriented processes for innovative crushing and selective separation of recoverable materials are developed scaled from laboratory to pilot plant size.

Together new possibilities to optimise the circle of materials are identified, always with the aim of a waste-free reuse of resources.

The methodical competences range from mechanical, physical, chemical to biological procedures and are enhanced and combined with respect to the corresponding final use.

Material systems in focus

- Combustion ashes and dusts
- Metallurgical slags
- Mineral systems
- Composite materials
- Vitreous materials of different shape
- Sludges form grinding, electroplating, drilling, effluent sludge, red mud and other industrial sludges

Mineral treatment and production residues

The focused material systems have much in common. They are usually produced in large quantities and contain low amounts of resources and/or pollutants. These substances - mostly metals - are embedded in an oxide or (alumino) silicate matrix with a good chemical stability.
The Project Group IWKS faces the challenge to develop methods allowing the economically feasible extraction of recyclables. These methods range from physical, chemical to biological approaches, depending on the kind, concentration and bond of the substance (metal) to be extracted.

Processing methods

- Mechanical processing (crushing, classification, grinding)
- Innovative separation technologies (electro-hydraulic fragmentation, sorting processes)
- Processes for the extraction of pollutants and resources (Mechano-chemical extraction, acid extraction, liquid/ liquid extraction, use of ionic liquids)
- Biological recovery of metals from mineral and organic sludges (bioleaching)
- Solid-gas technology for the selective separation of pollutants and resources

Landfills and resource stocks

Landfills are not a burden but a stock of resources worth to be recovered. This is as well reflected by the decision of the European Parliament to include "Enhanced Landfill Mining" in the EU Landfill Directive. The IWKS offers in close collaboration with numerous partners the following services:

- Development of new and optimisation of existing models for the estimation of potential resources in landfills
- Evaluation of current approaches to extract secondary resources from landfills
- Identifying potential markets for upcycling products
- Analysis of current political conditions, obstacles and drivers for enhanced landfill mining (ELFM) in the European context

Material characterisation

In order to develop efficient extraction technologies, a precise characterisation of materials with regard to material composition and structure, concentration, short-range order, stoichiometry, morphology, etc. is essential.

Therefore, numerous up-to-date characterisation methods are available. Next to qualitative and quantitative determination with highest resolution, they allow the measurement of various chemical - and physical properties of materials.
In addition, the portfolio is completed by a large variety of process-related examinations such as material flow analysis, process cost analysis, life cycle assessment (LCA), environmental accounting, sustainability assessment and resource efficiency issues.

Collection and analysis of data for buildings and infrastructure

The biggest fraction of the entire waste accumulation in Germany is construction waste. The composition of this waste type has substantially changed in the last centuries. For instance, ancient houses were made of mineral materials, wood and iron, while in modern buildings more than 100 materials are installed. Additionally, the fractions of used materials have drastically changed. The metal content, which was below one percent for many centuries, has increased to over ten percent in modern buildings. An accurate knowledge of this huge material stock is crucial for a constructive and efficient reuse of this enormous raw material potential.

- Fast acquisition of key figures, such as resource productivity or material flows
- Raw material quantities, raw material demands, etc. from macro to micro can be easily deduced
- Advertising media / public image
- Mapping of the historical urban development from a raw materials' point of view
- Digitalisation of the raw materials of urban regions