OUR PORTFOLIO

Overview at a glance:
- Analysis and characterization of valuables and pollutants in secondary raw materials and waste waters
- Development and optimization of recycling strategies
- Mechanochemical processing of mineral residuals
- Design of microbiological and chemical leaching and precipitation processes
- Synthesis of adsorption materials
- Biotechnological separation or elimination of substances from liquid media
- Exploration of bio-based by-products for a substitution of mineral oil-based materials
- Design of processes for the reprocessing of fibres and hemi-celluloses for bio-based materials, paints, textiles
- Enzymatic processing of bio-based residuals
- Development of biodegradable coatings for controlled release fertilizers

Technical equipment:
- High-resolution light and electron microscopy (REM, EDX)
- X-ray diffraction (both high temperature measurement)
- Raman spectroscopy
- Elemental analysis (ICP-MS, ICP-OES, WDXRF)
- Spectroscopy (FT-IR, UV-VIS)
- Chromatography (GC-MS, HPLC, IC)
- H2, O2, N2, C, S and Hg analysis
- Surface and pore analysis (BET)
- Particle size analysis (1 nm up to 30 mm)
- Static and dynamic fibre analysis

BIODIVERSE SYSTEMS

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Adaptation or new solutions of physical and chemical processes are necessary. In most cases, bio-based raw materials have to be isolated from their matrix. This requires high requirements on the quality of the raw materials for their use. Keys for a successful use are the isolation, reprocessing, and a quality management for the relevant raw materials. Therefore, processes for the recovery of natural fibres from by-products of the food industry, enzymatic degradation as a tool for the recovery of fibres from their matrix, and development of biodegradable coatings for fertilisers with a controlled nutrient release are of growing importance. For an optimisation of the resource efficiency, it is not sufficient to recover valuable resources but also to minimise and reprocess potential secondary wastes.

**Your challenges**

- Running short resources and accompanying rise in prices increase the part of raw material costs of a product. Furthermore, technologies and strategies for an efficient use of raw materials in industrial processes become more and more important.
- Wet chemical dissolution and precipitation processes are time-consuming, energy-intensive, and also inefficient. Development of particle-based adsorption systems for organic and inorganic elements or compounds is important possible saving. Also in technical processes and plants, the requirements on ecological and technical harmlessness are of growing importance.
- Population growth and increasing urbanisation push up the demand for water as drinking water and for agricultural production. Water resources are under threat due to increasing environmental levels. For an optimisation of the water cycles it is necessary to develop new advanced water treatment processes for the recovery of nutrients and valuable elements and compounds in waste waters, process waters, sludges and ashes. The increasing use of bio-based raw materials in various sectors in the industry provides access to prominent growth markets. The utilisation of these materials is increasingly limited to an ever-growing usage, and compost is biocomposite material. Cellulose-based polymers including nano-cellulose and bio-ethanol are the 3rd generation. The sources for bio-based raw materials are vegetable wastes from the food industry and agriculture. But also crops are grown especially for technical use. Keys for a successful use are the isolation, reprocessing, and a quality management for the relevant raw materials.

**Your advantages**

- High quality on raw material.
- In most cases, bio-based raw materials have to be isolated and reprocessed from their matrix.
- Availability of new solutions of physical and chemical processes for isolation and reprocessing.
- Security of supply and quality of raw materials.

**Our solutions**

- Development of processes for the recovery of natural fibres from by-products of the food industry.
- Enzymatic degradation as a tool for the recovery of fibres from their matrix.
- Development of bio-based raw materials.
- Development of biodegradable coatings for fertilisers with a controlled nutrient release.
- Analysis and evaluation of mass flows and development of resource efficient technological improvements.
- Completion of environmental performance evaluation.

**Background**

The increasing use of bio-based raw materials in various sectors in the industry provides access to prominent growth markets. The utilisation of these materials is increasingly limited to an ever-growing usage, and compost is biocomposite material. Cellulose-based polymers including nano-cellulose and bio-ethanol are the 3rd generation. The sources for bio-based raw materials are vegetable wastes from the food industry and agriculture. But also crops are grown especially for technical use. Keys for a successful use are the isolation, reprocessing, and a quality management for the relevant raw materials.

**BIO-BASED RAW MATERIALS**

- Development of processes for the recovery of natural fibres from by-products of the food industry.
- Enzymatic degradation as a tool for the recovery of fibres from their matrix.
- Development of biodegradable coatings for fertilisers with a controlled nutrient release.
- Analysis and evaluation of mass flows and development of resource efficient technological improvements.
- Completion of environmental performance evaluation.

**POLLUTANT REMOVAL AND RECOVERY OF NUTRIENTS**

Running short resources and accompanying rise in prices increase the part of raw material costs of a product. Therefore, technologies and strategies for an efficient use of raw materials in industrial processes become more and more important.

**Your challenges**

- Damage of ecosystems due to the overuse of mineral or farm fertiliser into surface and ground water where they cause environmental problems.
- fulfilment of ordinances (fertiliser regulation, REACH).

**Your advantages**

- Avoidance of harmful chemicals.
- Determination of economic and available raw materials.
- Simple and robust production processes with broad variation possibilities.
- Multiple-use of the same adsorption material due to desorption.
- Separation and recovery of minor concentration of pollutants and valuable elements and compounds in waste waters, process waters, sludges and ashes.

**Our solutions**

- Development of biogenic adhesion agents between fibres and matrices in composite materials.
- Enzymatic degradation as a tool for the recovery of fibres from by-products of the food industry.

**Background**

Sanitary issues in the field of ground- and drinking water are of growing importance. For an optimisation of the water cycles, it is necessary to develop new advanced water treatment processes for the recovery of nutrients and valuable elements and compounds in waste waters, process waters, sludges and ashes.

**NUTRIENT RECYCLING CONCEPTS**

Fertilisers as ammonia or nitrate are the main nutrient for plants. Even if nitrogren is the most abundant element in the air, the conversion into plant available forms via the Haber-Bosch process is very energy consuming. Furthermore nitrate and ammonia are water soluble and are easily transferred as mineral compounds into surface and ground water where they cause environmental problems.

**Your challenges**

- Different determining conditions in the periphery of the recycling plant.
- Different regional requirements for a recycling strategy.
- Fulfilment of relevant ordinances.

**Our solutions**

- Analysis of process and waste waters, sludges, ashes.
- Strategic and technological support for WWTPs, local authorities and municipalities.
- Design of regional recycling concepts.
- Strategic and technological support for wastewater treatment processes.
- Establishment of sustainable technologies.
- Development of marketable products.
- Saving due to reduced disposal costs.
- Involvement of stakeholders.

**Background**

Most of the phosphates that are mined end up as fertilisers in agriculture, but they also play an important role in preserving agents, flame retardants, de-flame water and softeners. Losing natural phosphate deposits in Europe are the reason for the rising awareness in terms of the criticality of this resource.

**Your advantages**

- Different determining conditions in the periphery of the recycling plant.
- Recovered nutrients not yet a recycling product (marketable fertilizer).
- Support during the transfer of ideas into a large scale production.
- Avoidance of harmful chemicals.
- Development of marketable products.
- Saving due to reduced disposal costs.
- Involvement of stakeholders.

**Our solutions**

- Fulfilment of ordinances (fertiliser regulation, REACH).
- Strategic and technological support for wastewater treatment processes.
- Establishment of sustainable technologies.
- Development of marketable products.
- Saving due to reduced disposal costs.
- Involvement of stakeholders.

**Pictures**

Nutrient recycling concepts, “Dragline”, Oliver Gantner, 2012. All other pictures © Fraunhofer Project Group IWKS