Continuous Selective High Gradient Magnetic Bio Separation Using Novel Rotating Matrix Centrifugation

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ABSTRACT

In the last decade biotechnological production processes using genetically modified mutant strains have established as a standard method. Due to the high efficiency of the "cell factory" in terms of catalysis and metabolic pathway the production of a wide range of known products as well as even a wider range of new product families has been facilitated. However standard downstream operations as adsorption chromatography are associated with strongly inefficient separation performance. As a result of intensive and expensive preconditioning of the fermentation broth product yield is dropping heavily in each processing step and price even skyrockets for some products. Therefore classical downstream processing is considered to be a bottleneck. By utilizing magnetic carrier particles with specific surface treatments a selective separation due to specific interactions of the target product out of the gross bio broth is possible. This approach allows highly efficient product recovery at a minimum of process steps.

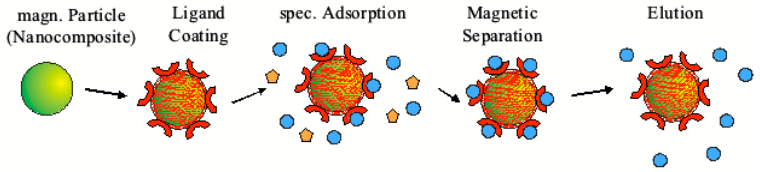

Fig. 1: Process chain of the selective magnet bio separation

However this new technology has not been transferred into industrial application yet, even though it is well established in micro scale for analysis applications. Apart from industrial reservation in the utilization of this novel technology, furthermore high price of reusable carrier particles with proper functionalizations and durability as well as not yet existing large scale magnetic separation equipment inhibit the transfer into industrial application.
Besides strong international research activity of academic as well as industrial institutions in the field of particle synthesis, also ongoing intense and successful development of novel particle processing equipment involving all necessary unit operations in need for a selective biotechnological production process can be reported.

As an example of this research work a novel magnetic separator utilizing a rotating magnetic matrix within an external magnetic field will be introduced. The combination of the HGMS principle with its high separation efficiency at low particle sizes with continuous centrifugation allows for large scale selective separation. The capacity limitation of classical HGMS filters is avoided by continues cleaning of the magnetic matrix due to centrifugal forces. Fig. 2 shows the particle pathway. These enter the centrifuge through the inlet and are captured at the matrix surface by magnetic forces. The rotation superposes a centrifugal force field, which is used to transport the particles along the wire and

detach them at the outer radius of the magnetic matrix. Further on the carrier particles may be removed continuously out of the rotating system to be processed in other unit operations.

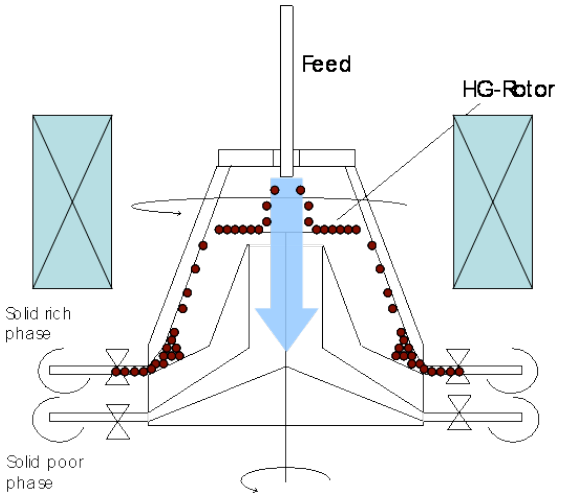

Fig. 2: Scheme of the novel Rotating Matrix Centrifuge

The experimental results (Fig. 3) show a strong dependence from flux density. At zero flux density separation is achieved only by centrifugation and efficiencies of up to 35% are reached. Applying an external field separation efficiency can be increased to more than 97% with a conservative setup.

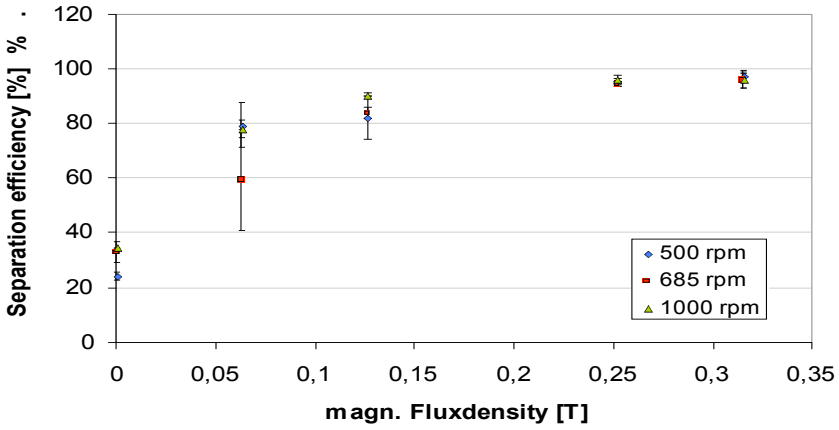

Fig. 3: Separation efficiencies measured at the centrate outlet of the apparatus

The proposed paper will present the basics of selective magnetic separation strongly focused on the novel separator design as well as experimental results. The work will be complemented by theoretical considerations.

Keywords: *magnetic separation, bio separation, centrifugation, magnetic field, selective separation, magnetic carrier*