



VERTICAL (ELECTRO)MAGNETIC SEPARATOR OF ISOMAGNETIC NANOPARTICLES

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Introduction

The invention of "**Vertical (electro)magnetic separator of isomagnetic nanoparticles**" refers to the manufacturing of a (electro)magnetic device which allows separation of the magnetic particles from the non-magnetic ones and the separation of the isomagnetic particles by class. The separation technology assumes the passing the magnetic fluid / magnetic suspension through a predefined / controllable magnetic field. From the constructive point of view, the magnetic separator implies one or more magnetic zones in which the isomagnetic particles are separated. For this purpose, it is possible to optimize the flow parameters and the magnetic field for each separation zone.

Obtaining method

- From the constructive point of view, the vertical magnetic separator assumes the existence of a magnetic fluid dosing system, an (electro)magnetic field generator, i.e. a (electro)magnet or a cylindrical or cylindrically arranged magnet system is passed through the magnetic fluid through a tube.
- In order to regulate the flow regime, the feed diameter and the separation diameter can be suitably adjusted to increase or decrease the separation capacity at the elementary separator level, and by suitable fitting the homogeneity of nanoparticle particles / assemblies can be adjusted.
- The vertical positioning of the separator is recommended because in the antigravitational flow regime it is allowed a stationary time in the magnetic field and implicit the possibility that these nanoparticles are attracted to the (electro) magnet while in the case of the gravitational flow (free fall), the time the stationary will be smaller, attracting to the magnet only certain nanoparticles with certain properties.
- In ascending flow, using a large $D:d$ ratio, during the passage of the magnetic fluid through the electromagnetic field, the flow will be laminar, allowing a better degree of separation for each elementary separation unit of the nanoparticles fraction that lead to the separation of the finer or coarser nanoparticles (Figure 2).

Elementary unit afferent to the vertical magnetic separator

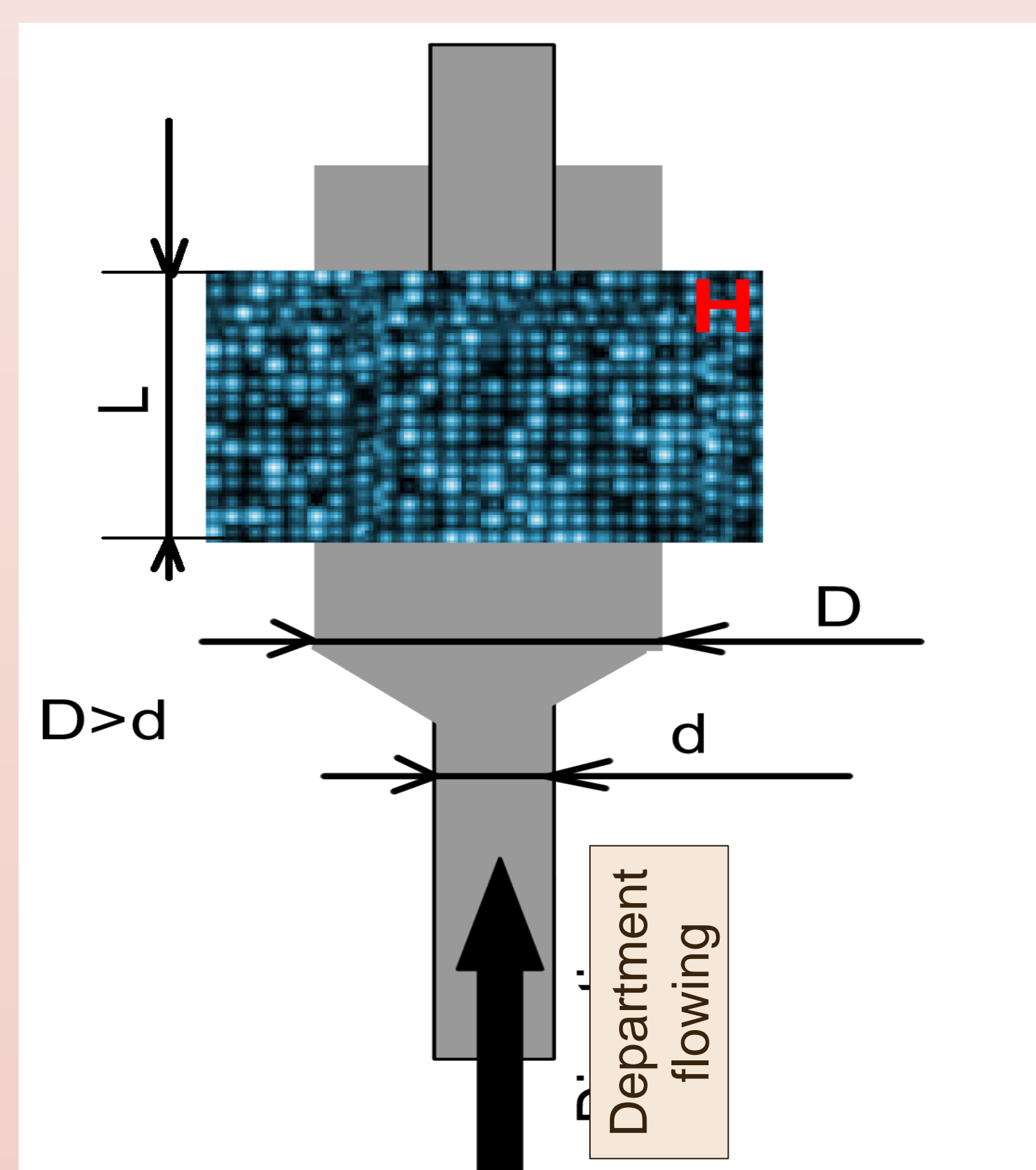


Figure 2. Schematic representation of the elementary element of the vertical magnetic separator

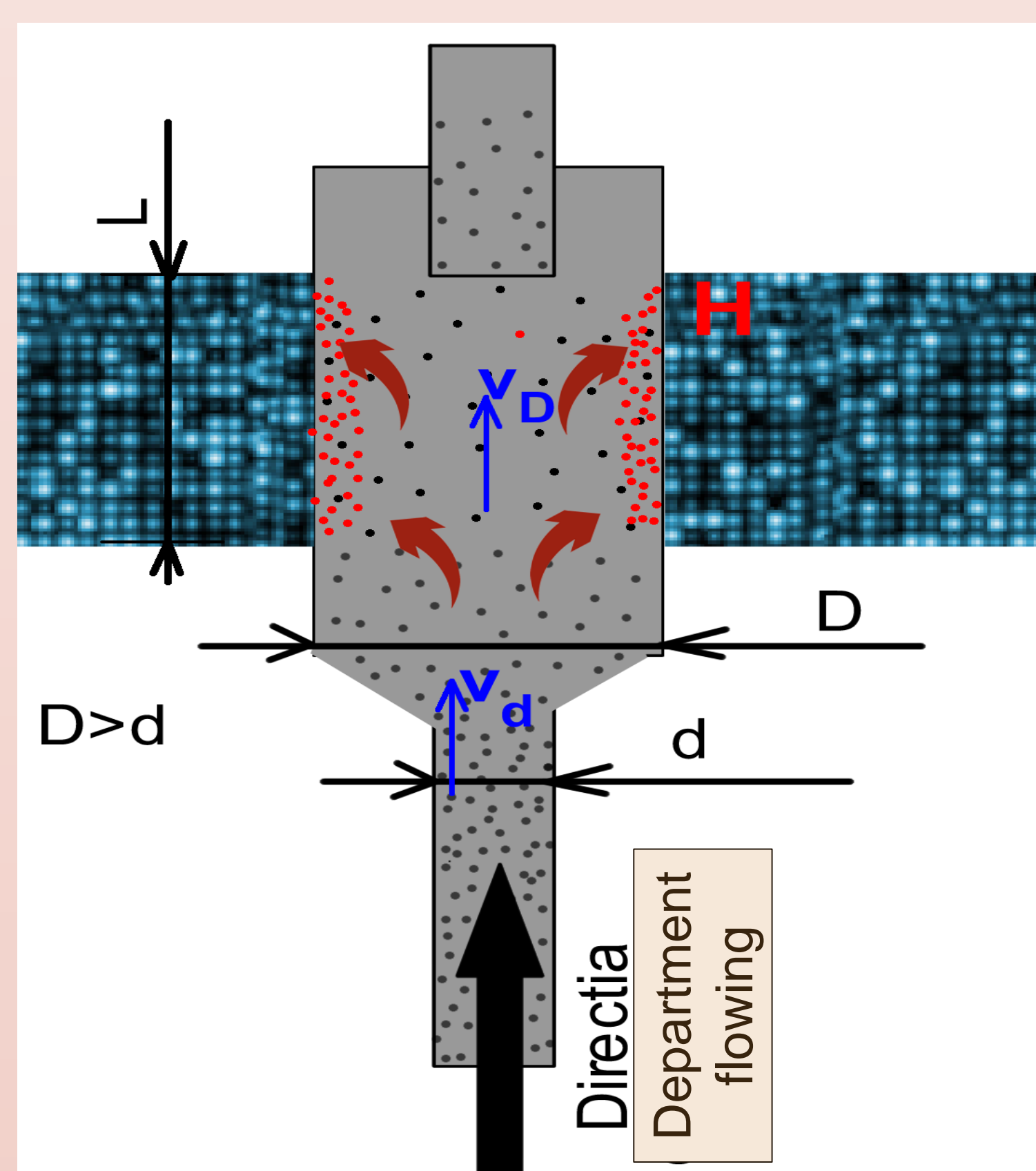


Figure 3. Schematic representation of the magnetic particle separation process inside the elementary element of the vertical magnetic separator

The invention advantages

- the proposed separation technique is extremely simple,
- can be realised in any laboratory
- involves a metering pump, magnets or electromagnets, and possibly an ultrasonic bath to maintain the magnetic particles in the solution, preferably in free, uncoated form.
- can be easily adapted to separate magnetic particles resulting from synthesis (elimination of secondary synthesis products);
- may be readily adapted for sorting magnetic particles by granulometric classes when a magnetic separator having multiple elementary separators is used.
- If the magnet is replaced by a solenoid, variable magnetic fields can be applied and it is possible to set the field so that only certain nanoparticles are attracted in the range spent by the magnetic fluid in the magnetic field area generated by the electromagnet;
- If two or more magnetic particle sorts are to be separated then two or more vertical elementary separators (Figure 5) may be inserted.

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Patent application

A 01055/05.12.2018.

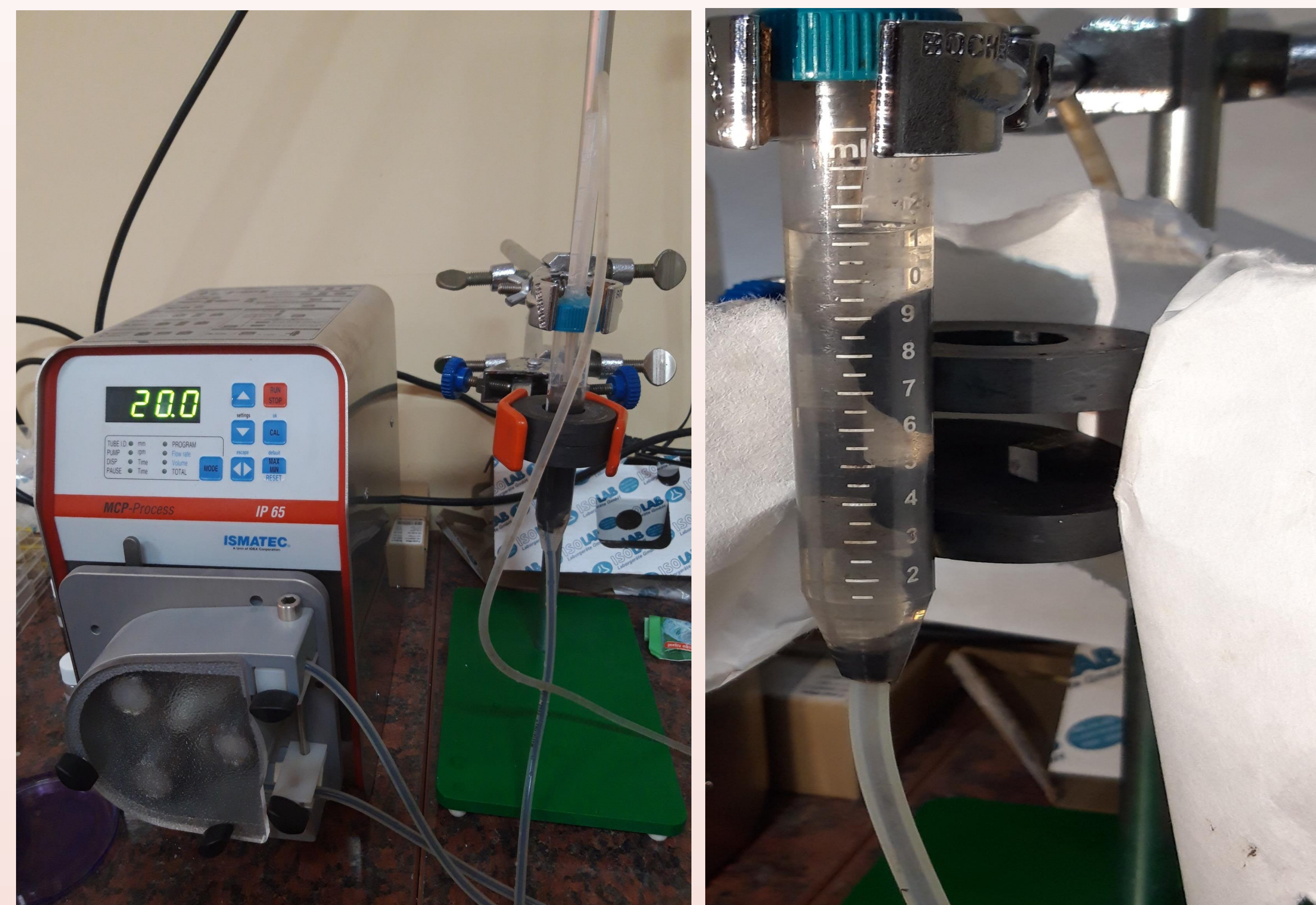


Figure 1. Experimental model for the vertical magnetic separator: a) elementary separator b) elementary with two individual separation zones

Technical solution

From a technical point of view, the functionality of the separator is ensured by the optimization of several parameters such as:

- Flow rate of magnetic fluid;
- Suspension ultrasonication for disaggregation;
- The ratio of the diameters of the two tube segments according to Figure 2, namely $d:D$, which induces fluid flow in the feed zone and the active / separation zone respectively;
- Characteristics of the applied magnetic field (field intensity - H ; length of the area where the (electromagnetic) field is applied - L);
- Viscosity of the suspension;
- Number of elementary separation units;
- Homogenizing the fluid between two elementary separation units.

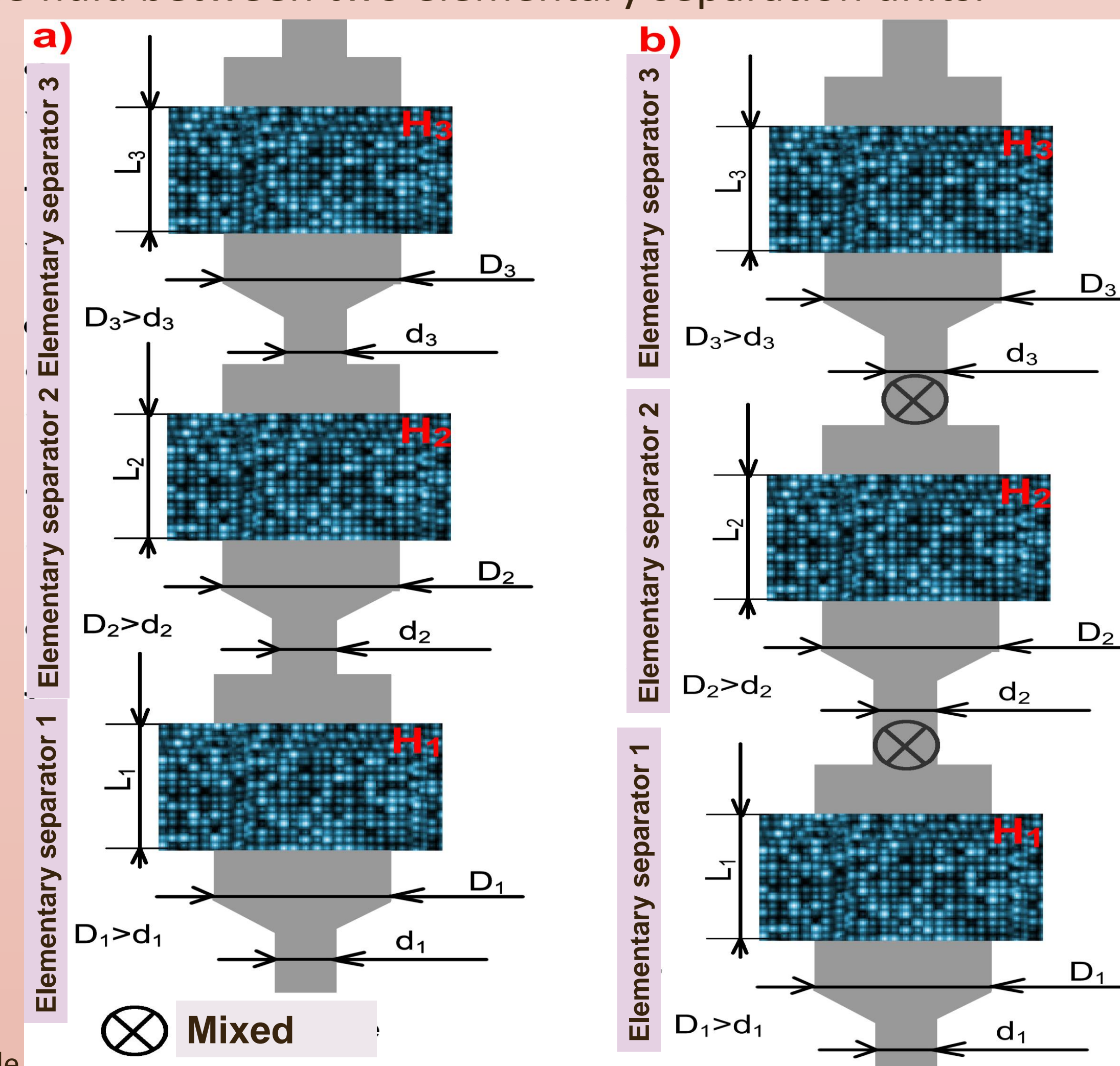


Figure 3. Modular vertical separator with 3 separating elements, a) without and b) with intermediate mixing