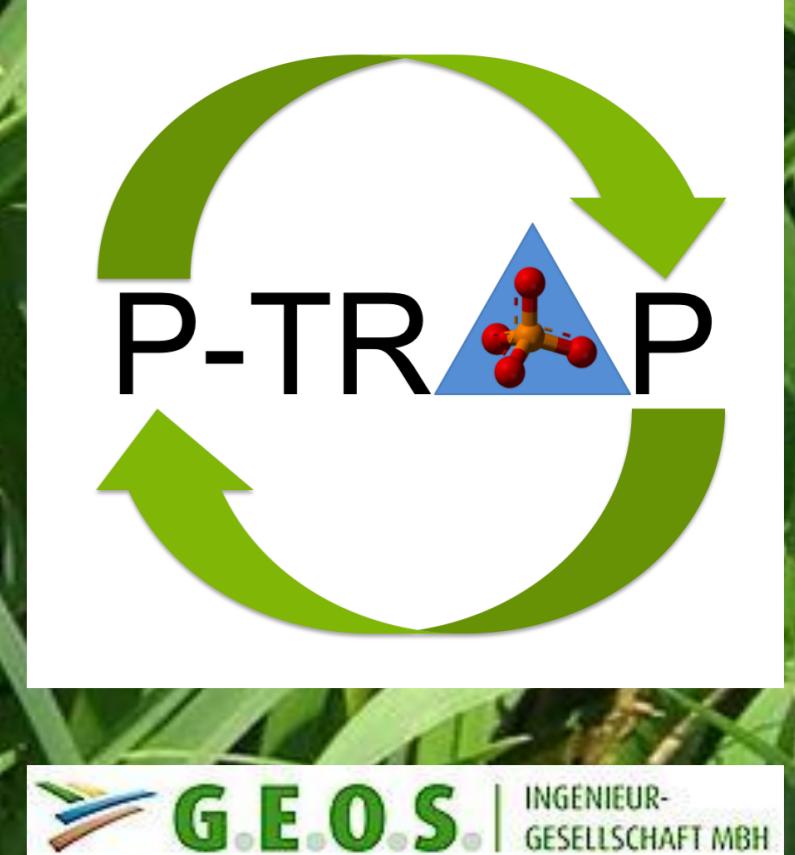




Granular iron-based materials for phosphate removal from waters

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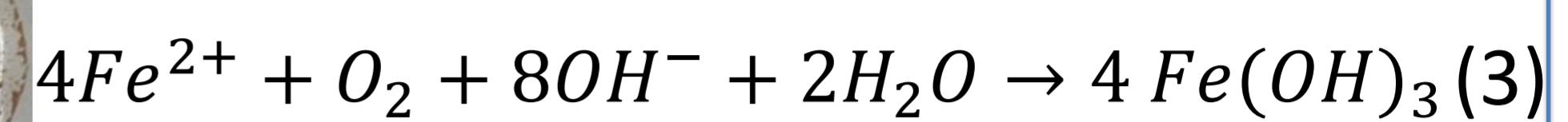
1. Origin of iron-based raw materials



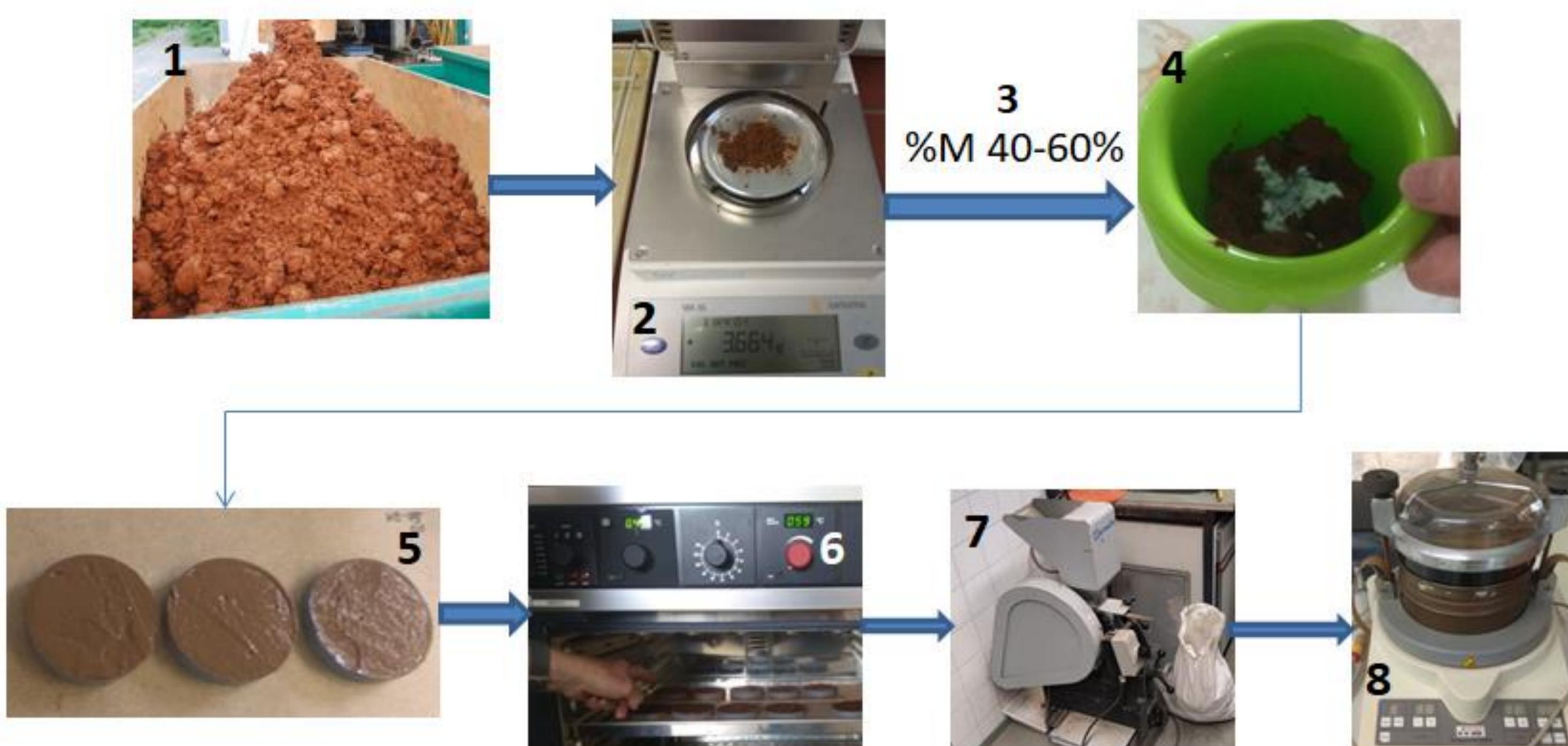
Schwertmannite (SHM) is a naturally occurring mineral that forms during the oxidation of ferrous to ferric iron at low pH (2.8-4.5). The ironhydroxysulfate exhibits a molar ratio: Fe : SO₄²⁻ of 8.00 : 1 or 4.57 : 1, respectively.



Sludge comes from a groundwater treatment plant in Noordbergum (the Netherlands). Stage of oxidation.



2. Agglomeration process and production of filter-stable iron-based granular materials



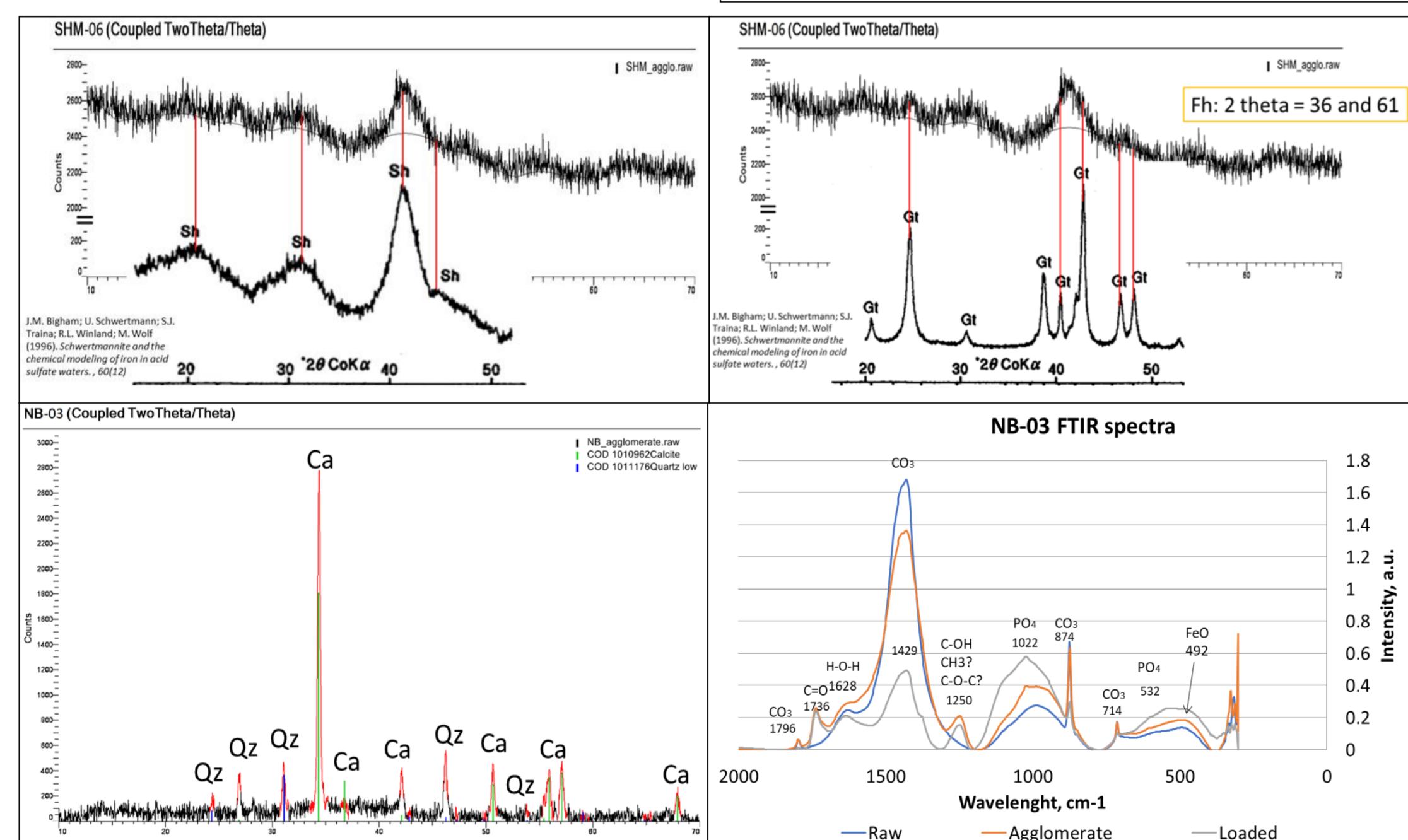
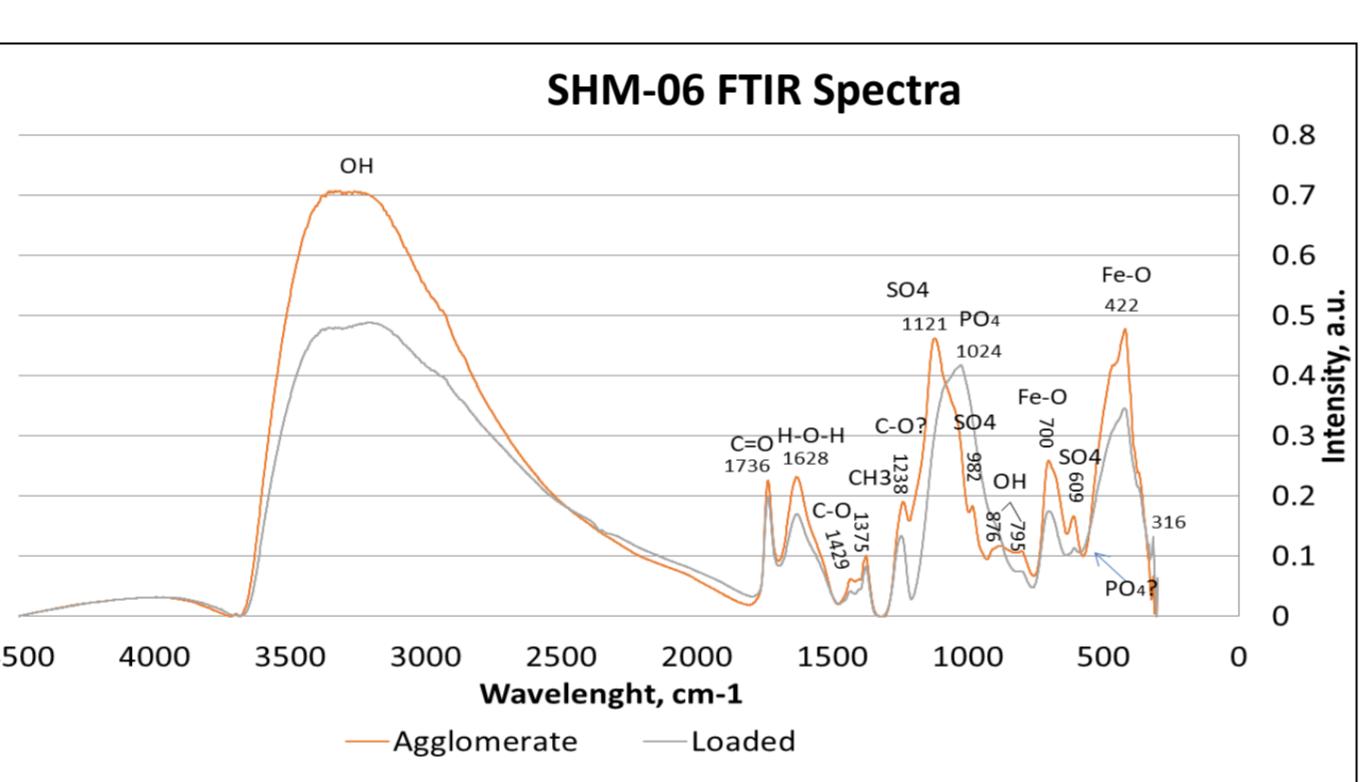
The process of agglomeration consists of the following steps:

1. Collection of the iron-based raw materials;
2. Moisture content determination;
3. The raw material is set to the necessary content of moisture;
4. Material is mixed with the binder in a specific relation one to another;
5. The homogeneous mixture is placed into a form;
6. Mixed formatted material is placed for drying;
7. The dried material is crushed;
8. The crushed material is sieved to obtain the required filter fraction: 0.5-2 mm.

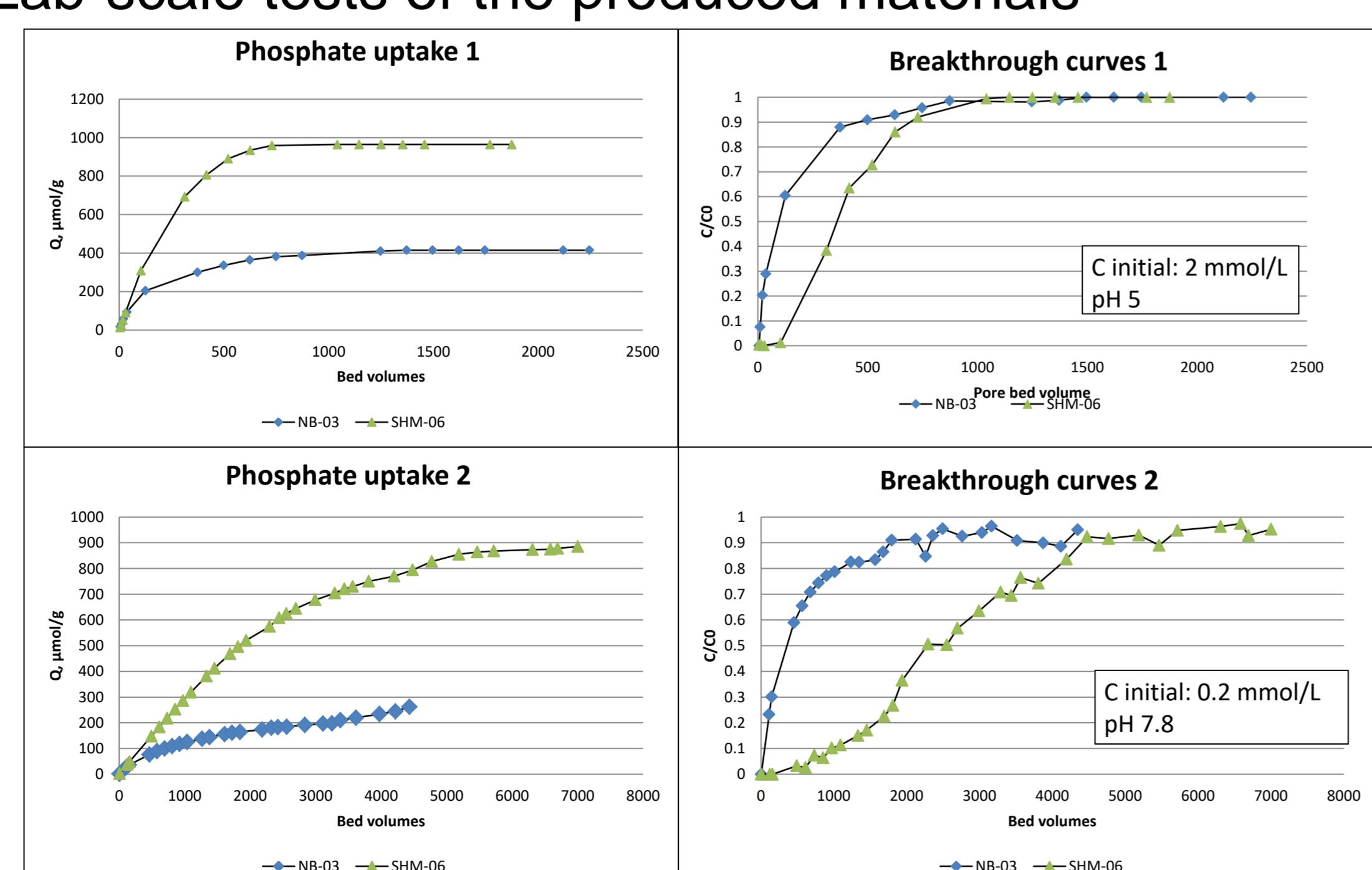
3. Characterization of produced iron-based filter-stable materials

Characteristics	NB-03 Noordbergum (Fe-hydroxide)	SHM-06 Saxony (Schwertmannite)
Bulk density, (g·l ⁻¹)	0.52	0.54
Grain (true) density, (g·l ⁻¹)	2.94	2.89
Porosity, (%)	82.4	81.3
Grain size, (mm)	0.5-2	0.5-2
Filter stability, (%)	95	96
Undersize% by mass	1.69	4.9
Specific surface area (m ² ·g ⁻¹)	79 ¹⁾	30 ¹⁾
Pore size average (nm)	4.575 ¹⁾	1.299 ¹⁾
Maximum P uptake, mmol/g	0.41	0.96

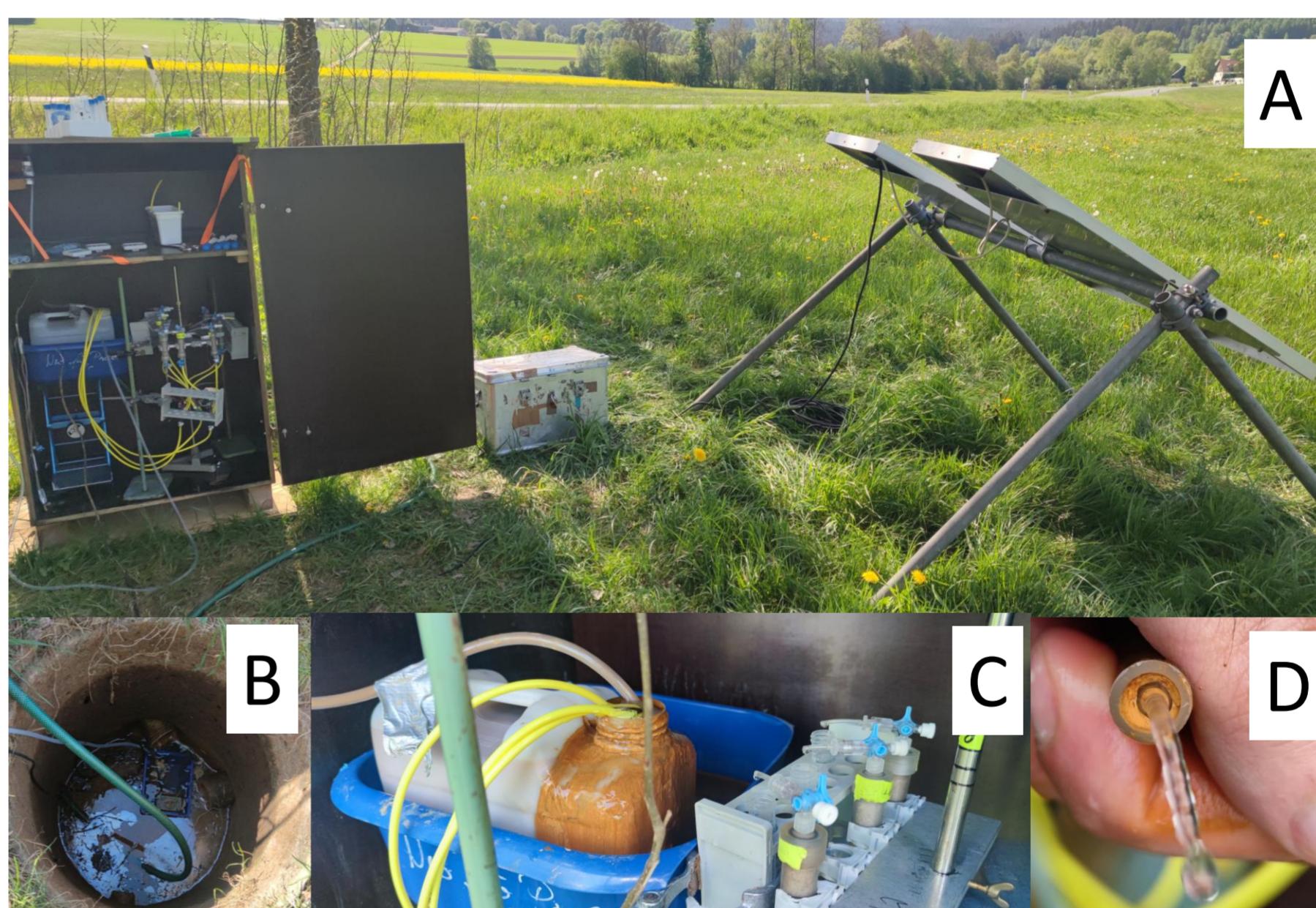
¹⁾ data provided by Bayreuth University



4. Lab-scale tests of the produced materials

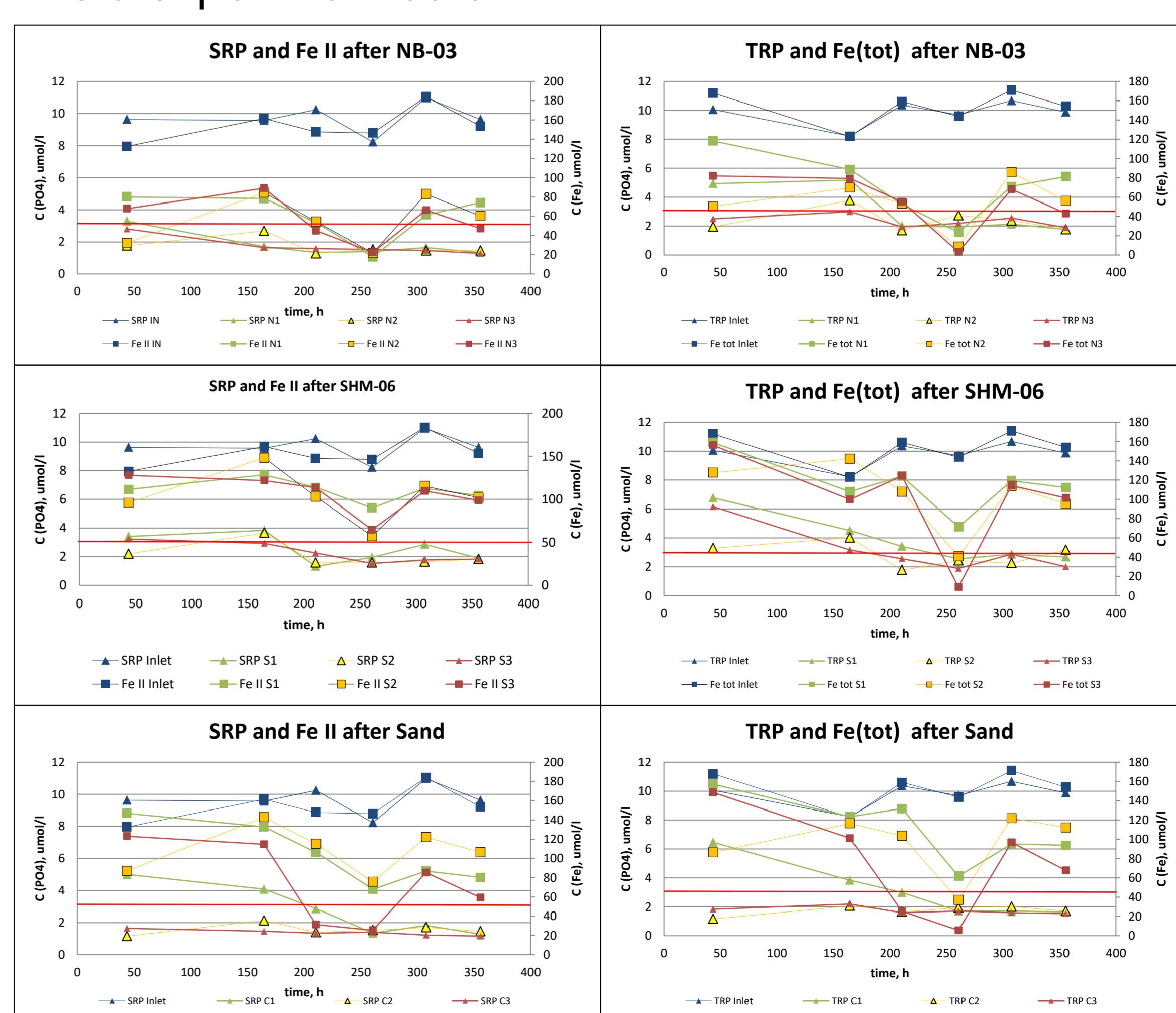


5. Field application of the materials



- A) Field site complete setup;
- B) Collector – a source of drainage water;
- C) Header container that feeds the columns;
- D) Clogging inside the tube (from the pump to the header container).

6. Field experiment data



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