Fiberbanks as substrate and feedstock for biological remediation:

A practical analytical method development for organic pollutants analysis

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Fiberbanks introduction

Fiberbanks from the pulp and paper industry are typically **contaminated** with a wide range of **hydrocarbons** ,**chlorinated compounds** and **heavy metals** (Fig.1).

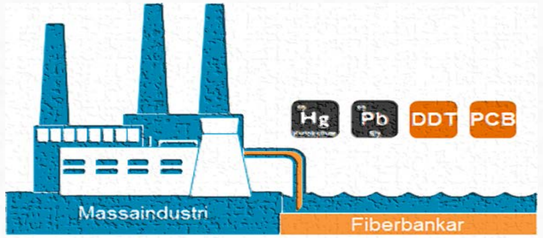

Figure 1: Historical pulp and paper mills releasing untreated wastewater with harmful chemicals in the aquatic ecosystem, until legislation passed in 1969[1]. Illustration from BioRem Fiber Projects[2].

This poses a formidable challenge for the analyst to **develop an appropriate method of screening for different groups of chemicals** at once. This would **enable a quick identification** of target analytes in the **various fiberbanks** and tailor, if necessary, the sample manipulations accordingly. **A reliable data collection and analysis** are essential for the monitoring of the remediation activities of the **BioRem Fiber project**.

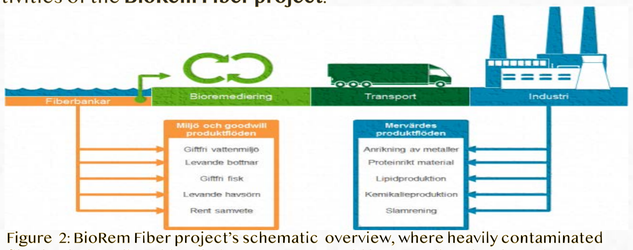

Figure 2: BioRem Fiber project's schematic overview, where heavily contaminated fiberbank sites disturbing their ecosystems could be remediated and turn into valuable product such as biomass for biodiesel production; protein production for animal feed and etc. [1]

Feedstock treatment

The potential **alterations in organic contaminants** levels, when the **fibrous sediment material** is **pretreated**, must be evaluated before its use as a **feedstock** for bioremediation. **Physico-chemical treatments can include: freeze-drying, air-drying, autoclaving, etc**.

Briefly, the different **feedstock pre-treatments** are likely to be used for **different organisms or cultivation techniques**. Hence, knowledge about the **initial condition of the material**, once treated, is very important for the **latter evaluation on the remediation process**.

Fig 4: Poa Annoa and Brassica Juncea growing in 90 % fiberbank material and 10 % sand [4].

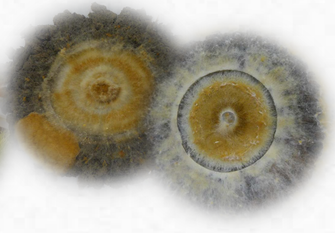

Fig 5: Two fungi species growing on fiberbank feedstock (2 months growth)

Project's goals

Our purpose is to **evaluate the organic pollutant contents** of the fiberbank material for **monitoring** the studied **remediation systems** used upon it. Moreover, we shall try to **reconcile several method of extraction and analysis** under one roof, in order to **simplify** the **downstream sample processing**.

Research questions

Can different **physico-chemical treatments** of the fiberbanks **influence the organic pollutants contents** of the material?

Can **streamlining the sample preparation** yield an appropriate analysis for PAH, PCBs and OCPs when using GC-FID-ECD?

Could the **ASE in-line-clean-up** rival the two-step extraction + SPE method and save time and solvent?

Will the analytical method reveal its usefullness once **repeatability and reliability** are expected?

Fiberbanks Sample Prep, Clean-up & Recovery

In preparation to this undertaking, an examination of a practical analytical method, using **one extraction method** and **one clean-up**, must be defined for the **analysis** of the compounds found in the **fibrous sediment**. The chosen method resolves around the use of the accelerated solvent extraction (**ASE**), solid phase extraction (**SPE**) and **GC-FID_ECD analysis**.

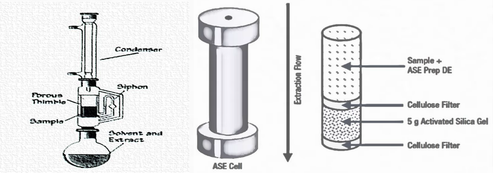

Figure 3: Example of a general solid-liquid extraction that will undergo a SPE (Left). ASE-in-line-clean-up, combining both extraction and clean-up in one step (Right)[3].

Finally, the **on-going analytical screening** using the two detectors, as well as, the **separation of the hydrocarbons and the chlorinated compounds** looks promising. This first lead, on **characterizing** the **fiberbank**, is a step towards a **more efficient** and **reliable method** for the **on-going monitoring experiments**.

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References

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2- https://www.miun.se/bioremfiber

3- Galbiati, F., n.d. Determination of Total Petroleum Hydrocarbons in Rubble and Soils by Accelerated Solvent Extraction and GC-FID, ThermoFischer.