

# Scientific Report of Short Term Scientific Mission

**Cost Action Number:** E48

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## 1. Aim of the STSM

The main objectives were contact establishment between UCM and LUT in the membranes separation technology for Pulp and Paper Mills. Main objectives of the visit were:

- Transferring knowledge of membrane applications for future research at UCM, with an special attention to:
  - Microfiltration (MF)
  - Ultrafiltration (UF)
  - Nanofiltration (NF)
  - Reverse Osmosis (RO)
- Visiting LUT laboratories for membrane characterization and technology.
- Future collaborative research in membrane processes for closing water circuits in Pulp and Paper Mills.

## 2. Personnel involved in the STSM

Marianne Nyström, Professor, Head of the Laboratory  
Mika Mänttari, Docent, Research Lecturer (*Nanofiltration*)  
Arto Pihlajamäki, Dr. Tech, Assistant (*Membrane Characterization*)  
Jutta Nuortila-Jokinen, Docent outside LUT (*Membrane technology in pulp and paper industry*)  
Mari Kallioinen, PhD. Student (*UF and Membrane fouling in the pulp and paper applications*)  
Jukka Tanninen, Dr. Tech. (*Importance of charge in nanofiltration*)

### 3. Developed tasks in the STSM

#### 3.1. Transferring knowledge

LUT Membrane Technology and Technical Polymer Chemistry Laboratory has a wide experience in membrane applications make this research group to have a great membrane knowledge database and to be a great knowledge generator. The laboratory personnel provide great amount of LUT internal publications:

- Dissertation thesis of Jutta Nuortila-Jokinen and Jukka Tanninen.
- Internal reference books on membrane-based technologies and hybrid processes.
- Some theory books about membrane characterization and design
- Journal publications of the research group in: membrane characterization, importance of charge in nanofiltration and closing water in pulp and paper mills.

LUT databases are rather different from UCM, except for Elsevier (*ScienceDirect*) and ACS journal databases. Then, an intense searching in database not available at UCM was made for:

- Membranes fouling with inorganic compounds as silica
- Removal or treatments of the concentrate from membrane processes (UF and NF)
- Effect of refractory compounds for membrane processing in pulp and paper mill water streams.
- Biofouling in MF, UF, NF and RO

At the end, more than 100 works were collected.

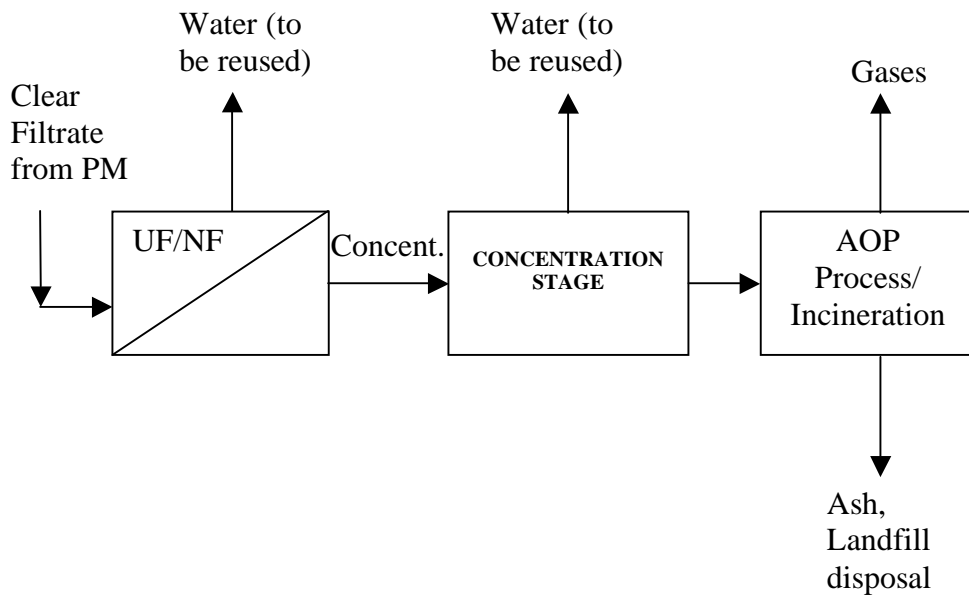
#### 3.2. Visiting LUT Membrane laboratories

Items visited during the STSM were:

- Membrane Technology (Mari Kallionen)
  - Pilot Plant
    - Tubular membrane modules
    - Experimental Cross Rotational (CR)-Filters for UF and NF
    - Vibratory Shear Enhanced Processing (VSEP) modules for UF
    - Spiral wound modules
  - Laboratories
    - Lab scale membrane testers, including cross-flow modules
- Membrane Characterization (Arto Pihlajamäaki)
  - Streaming and membrane potential (Apparatus of LUT design)
  - FTIR spectrometer and Raman spectrometer for membrane and fouling layer composition
  - Contact angle measurement for hydrophobicity and surface energies investigation of membranes
  - SEM for surface and fouling layer characterization

### 3.3. Future collaborative research

My purpose in this visit was to establish contact with LUT Membrane lab in order for a future postdoctoral grant application. New trends in closing Pulp and Paper Mills water circuits in LUT are the concentrate treatment of UF or NF retentates. As Dr. Nuortila-Jokinen is the research manager of UPM-kymmene Kaukas Paper Mill, she wrote a draft proposal for new research, which is summarized with the next figure:



The aim for a future work is to develop a new concentration stage for the retentate, which can be an oxidation, membranes, precipitation or evaporation process. Problems of UF/NF concentrates are that they are too dilute for Incineration or Advanced oxidation processes (AOP) but they are too concentrate for its reuse. Then, a new concentration stage is needed in order to avoid biological treatment of the retentate.

Prof. Marianne Nyström proposed some tasks for a future project:

- Literature search
- Simulation of best possibilities and prior economic evaluation
- Search for valuable compounds in the membranes concentrates
- Experimental work with chosen process(es) or technique(s)
- Study on process feasibility