

ANQUE 2010

Application of 3FM[®] technology to Pulp and Paper Waste Water Filtration

S. Mauchauffee*, MP Denieul*, B. Desvarreux-Larpenteur*, M. Coste*

*** VEOLIA Environnement Recherche & Innovation**



AGENDA

- **Aquafit 4 Use context and objectives**
- **3FM Technology**
- **Lab-scale Unit**
- **Results on Pulp & Paper Wastewater**
- **Conclusions**

Aquafit 4 Use

■ Context:

- By consuming several billions m³ of water a year, industry has a significant impact on available water sources. Water re-use through the treatment of their wastewater to produce water qualities according to their own specifications, can reduce significantly this impact. Four sectors are focused in this project: Pulp & Paper, Textile, Chemical and Food industries.

■ Objectives:

- Production of fit-for-use water from industry wastewater
- Closing water loop to reduce water consumption and reject

■ Meaning:

- Development of new technologies
- Evaluation of technologies coming from drinking water or municipal wastewater on industrial wastewater: case of 3FM

3FM[®] technology

■ 3FM = Flexible Fiber Filter Module.

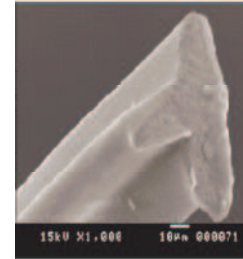
- New high speed filtration system
- Principle of solid-liquid separation by media filtering and capillary phenomena
- Alternative to conventional solid-liquid filtration, especially to sand filter
- Filtration velocity is higher more than 10 times compared with existed rapid sand filter
- Minimum space required
- Used as tertiary treatment to remove suspended solid
- Consist of a vertical column in steel (module), filled with fine fibers as porous filtration media



3FM[®] technology

■ Filtration media:

- Developed by NanoEnTech
- Made from polyamide, three branched star shape
- Flexible fibers which have softness, elasticity and a degree of surface roughness
- The filter is packed with bundle of fibers along the module length and around the collector of treated water which allows a deep bed filtration



3FM[®] technology: principle

- Alternation of filtration period and backwash
- **Filtration process:**
 - Raw water is fed through the inlet pipe of the lower part of the filter module and introduced uniformly into the flexible fiber filter layer.
 - During the filtration process, the suspended solids particles are captured on the media surface and in the pores created among the fibers flowing in the co-current direction.
 - Filtered water is discharged to upper port.



3FM[®] technology: principle

■ Backwash process:

- Using low pressure and water
- Short times and low water consumption (less than 2% of the total flow)
- Initiated by timer, turbidity degradation or increase of pressure (due to SS clogged in the filter)
- Suspended solids are displaced and removed by the turbulent flow and shearing force created by alternate cycles of air and water
- Dirty backwash water is discharged from the upper port



3FM[®] technology: specifications

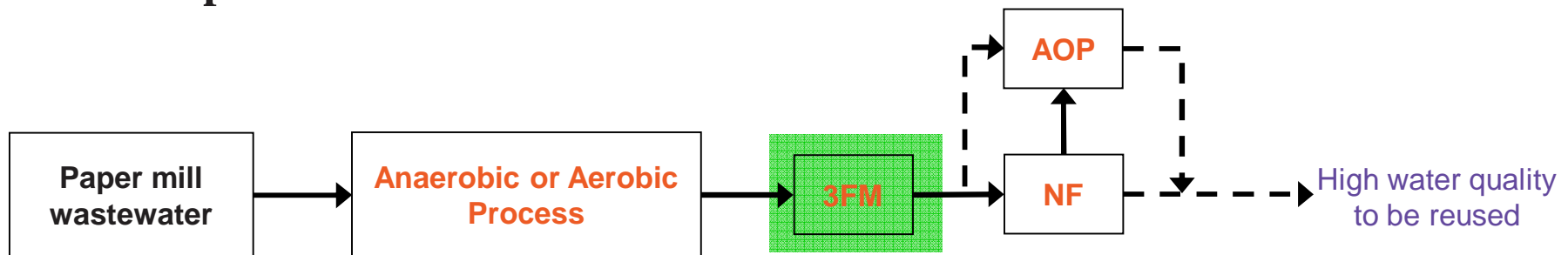
■ Core technologies:

- Flux rate: 2,000 ~ 5,000 m³/m²/d
- Large capacity of filtration: 10,000 ~ 12,000 m³/day with single module.
Possibility of having several modules in parallel
- Compact footprint: 1/10th the space of sand filter
- Deep bed filtration:
 - ✓ Pressure = 0.2 to 0.6 kg/cm²
 - ✓ Cut size = 5 – 10 μm
 - ✓ Requirements: Suspended Solid input = 50mg/L → suspended solid output less than 5 mg/L
- Backwash:
 - ✓ Every 7 hours approximately
 - ✓ 3 minutes
 - ✓ Less than 1% of the maximum treated water

- ## ■ Applications: sewage treatment plant – treatment of drinking water (Korea, China...)

3FM[®] technology: application in P&P industry

- In tertiary treatment, after a biological treatment
- To fine-tune the quality of the effluent produced by biological treatment with the inlet specifications of AOPs and membrane processes

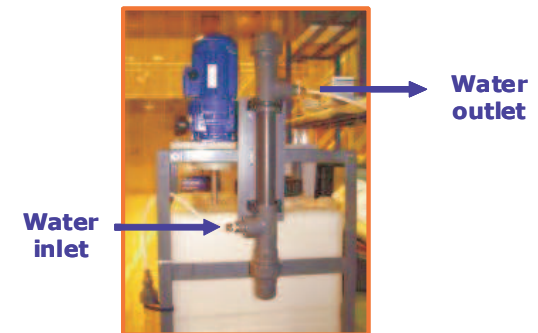
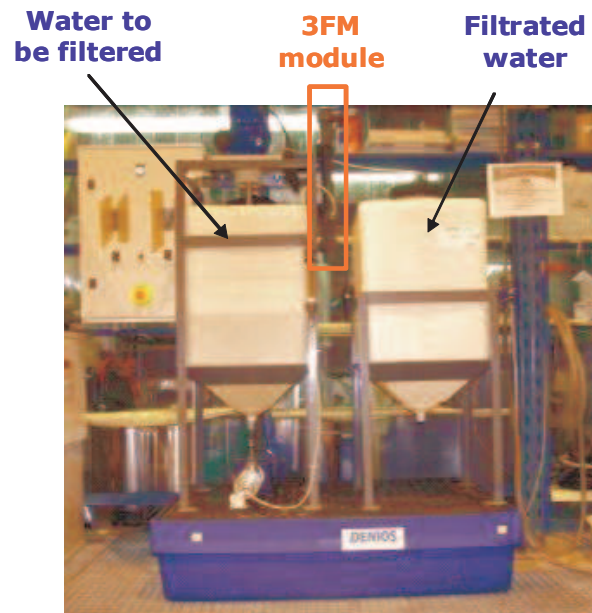


- Tests performed on 2 Pulp & Paper wastewaters

3FM: lab-scale unit

■ 3FM : bench scale unit

- No backwash
- Not representative of the hydrodynamics of real 3FM
- Allow to determine the **QUALITY** of outlet **WATER** in function of inlet
- Performance: removal of suspended solid and turbidity



3FM: lab-scale unit

■ 3FM : treatment conditions

- 100L of raw water
- Velocity = 65L/h
- Followed parameters:
 - ✓ TSS
 - ✓ Turbidity
 - ✓ COD

- 2 different raw waters coming from two pulp & paper industry which have the same characteristic in terms of TSS

3FM: treatment of raw water A

■ Feed characteristics: effluent from (anaerobic + aerobic) treatment

TSS (mg/L)	20	Al (µg/L)	110
TS à 105°C (mg/L)	2940	B (µg/L)	640
Turb (FAU)	34.2	Ca (mg/L)	71
TA (°dF)	0	tFe (mg/L)	0.41
TAC (°dF)	111	K (mg/L)	10
BOD ₅ (mgO ₂ /L)	50	Mg (mg/L)	6
tCOD (mgO ₂ /L)	644	Mn (µg/L)	700
sCOD (mgO ₂ /L)	631	Na (mg/L)	680
DOC (mgC/L)	170	Sr (µg/L)	500
COT (mgC/L)	180	Cl ⁻ (mg/L)	150
SO ₄ (mg/L)	470	F ⁻ (mg/L)	< 1
N-NH ₄ (mgN/L)	93		
N-NO ₂ (mgN/L)	74		
N-NO ₃ (mgN/L)	22	pH	7.9
P total (mgP/L)	18	T (°C)	16.5
P-PO ₄ (mgP/L)	16	C (mS/cm)	3.4

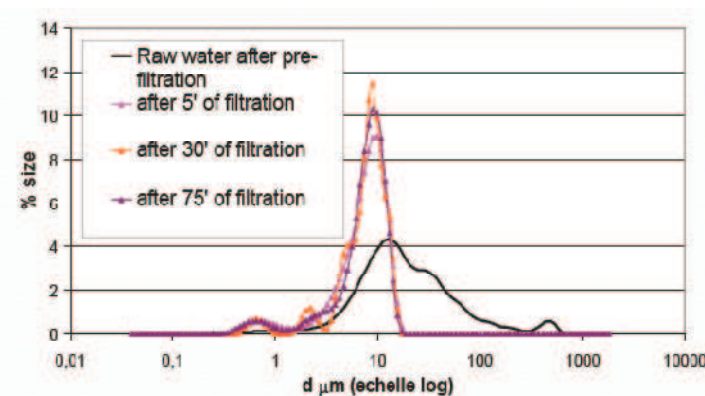
3FM: treatment of raw water A

■ Results:

TSS (mg/L)	6
Turb (FAU)	8
tCOD (mgO ₂ /L)	613
pH	7.9
C (mS/cm)	3.4

- Turbidity divided by 4
- TSS divided by 3.5
- No impact on soluble COD, removal of particular COD

■ Granulometry: cut off 10μm



3FM: treatment of raw water B

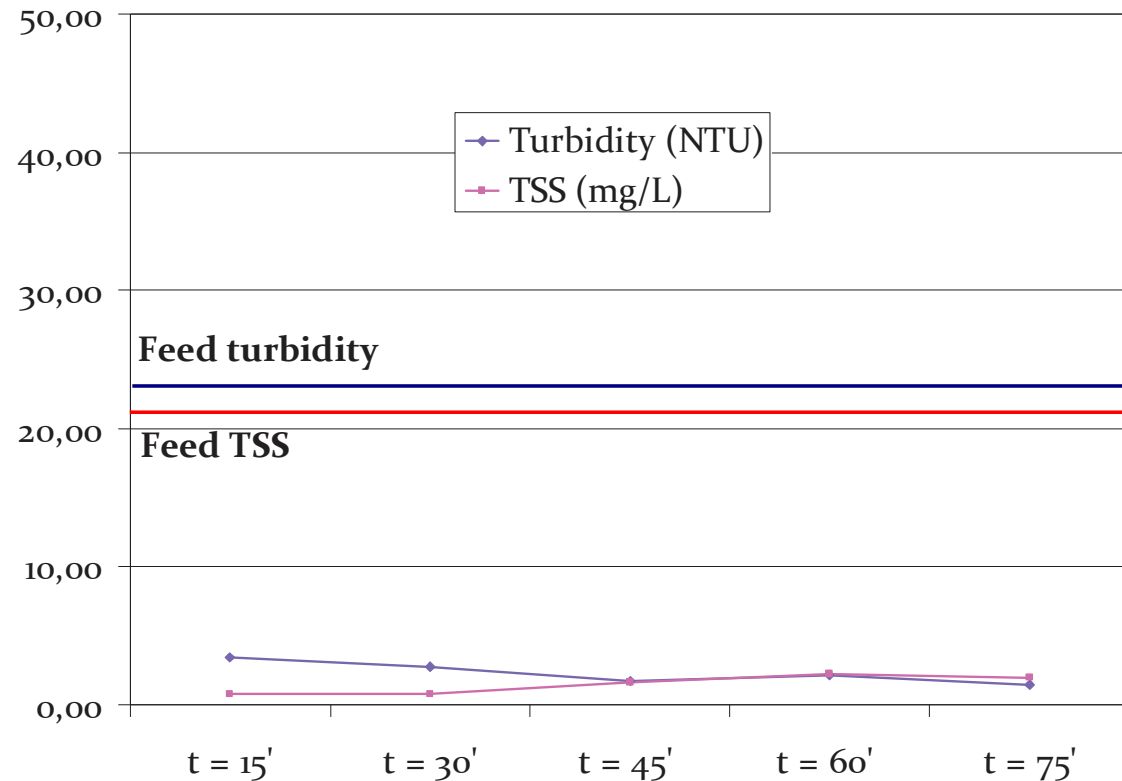
- **Feed characteristics:** coming from clarifier just before reject

TSS (mg/L)	23	Al (µg/L)	210
TS à 105°C (mg/L)	1700	B (µg/L)	2600
Turb (FAU)	21	Ba (µg/L)	100
TA (°dF)	0	Ca (mg/L)	140
TAC (°dF)	115	tFe (mg/L)	0,22
BOD ₅ (mgO ₂ /L)	52	K (mg/L)	9
tCOD (mgO ₂ /L)	154	Mg (mg/L)	20
sCOD (mgO ₂ /L)	144	Mn (µg/L)	20
DOC (mgC/L)	43	Na (mg/L)	400
COT (mgC/L)	46	Sr (µg/L)	580
SO ₄ (mg/L)	60	Cl ⁻ (mg/L)	180
N-NH ₄ (mgN/L)	1	F ⁻ (mg/L)	< 0,2
N-NO ₂ (mgN/L)	0,52		
N-NO ₃ (mgN/L)	0,22	pH	8,09
P total (mgP/L)	0,6	T (°C)	24,3
P-PO ₄ (mgP/L)	< 0,6	C (mS/cm)	2,68

3FM: treatment of raw water B

■ Results:

- TSS ≤ 2 ppm divided by 10
- Turbidity ≤ 3 NTU divided by 8
- No impact on COD, pH and C



3FM: conclusion on P&P waste water

■ Raw waters:

- Present the same concentration of TSS \approx 20mg/L

■ Promising results

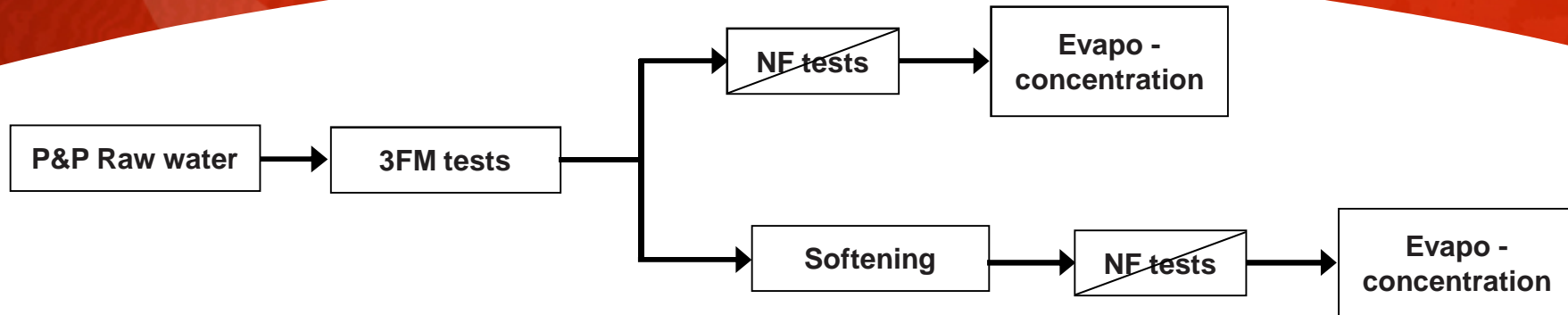
- Abatement of TSS: 75 to 90%
- Abatement of turbidity: 75 to 85%

■ Bench scale unit:

- No backwash
- Not representative of hydrodynamics

■ Results should be better at pilot scale (performed on site within the coming year)

3FM: to be tested on industrial site



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Thank you for your attention !

Any questions?