# TESTING THE EFFECTIVENESS OF DETERGENTS FOR REGENERATING A MICROFILTER MEMBRANE CLOGGED WITH WHEY


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## I. OVERVIEW:

The research is connected to the membrane filtration of whey-containing waters generated during dairy processes to enrich the proteins. However, it is well known that the membranes – despite their excellent selective separation properties – are significantly fouling or clogging, so regeneration is necessary for the sustainable use of the technology. Therefore, the goals of the present research was to investigate the cleanability of the whey-fouled polymer (polyethersulfone) membrane to increase its service life, which is also important due to the environmental and economic benefits of the technology. For this purpose, the effectiveness of different detergents were investigated for cleaning polymer membranes fouled with whey, which were developed in connection with an international TÉT project by UNICHEM Ltd.

## II. MATERIALS AND METHODS

- **Membrane**: polyethersulfone, Labex Ltd., FilterBio® PES membrane filter, 0.22 µm pore size
- **Whey powder**: BioTechUSA 100% pure whey protein drink powder (natural, unflavored)
- **COD measurements**: Lovibond® MD200 COD Vario Photometer
- **pH measurements**: HANNA Instruments, Portable pH Meter
- **EC, salt, TDS content**: Voltcraft® KBM-90 Combination Measuring Device

### DAIRY WATERS:

**Model whey water**
6 g whey powder + 100 mL UP water

**Produced/real whey water**
*Produced in SOLE-MIZO Ltd. factory, Szeged (HU)*


| | COD [g/L] | | |
|---|---|---|---|
| | Initial | Retentate | Permeate |
| Model (6g/100 mL) | 96.0 | 127.5 | 29.2 |
| Real | 63.6 | 61.4 | 45.3 |

### MEMBRANE FILTRATION (Millipore XFUF07601)

PES MF membrane (0.22 µm pore size)

$V_{total}$=100 mL ➡ $V_{permeate}$=50 mL + $V_{retentate}$=50 mL (VRR=2)

ΔP=1 bar

### CHEMICAL CLEANING

*Detergenst were developed by Unichem Ltd. (HU)*

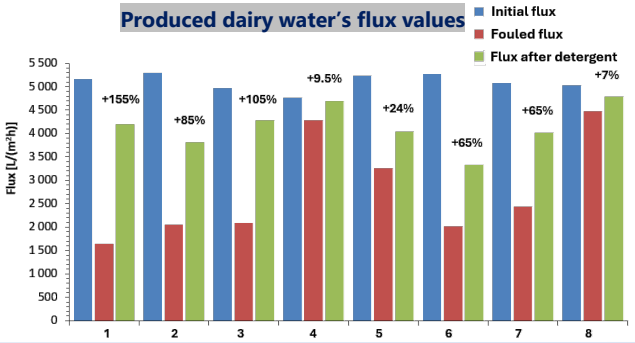
$V_{cleaner}$ =50 mL; ΔP=1 bar

## III. RESULTS

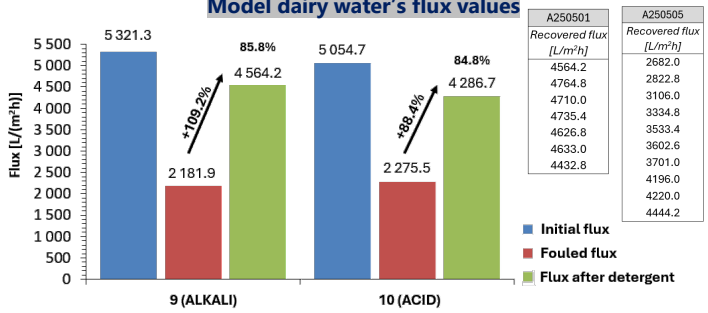
### Analytical properties of detergents

| Sample No. | Code | pH | EC [µS] | Salt [ppm] | TDS [ppm] |
|---|---|---|---|---|---|
| 1 | B250613 | 6.1 | 202 | 96 | 136 |
| 2 | B250614 | 6.0 | 341 | 162 | 229 |
| 3 | B250616 | 6.2 | 468 | 220 | 306 |
| 4 | B250619 | 6.0 | 599 | 289 | 402 |
| 5 | B250620 | 5.8 | 177 | 83 | 118 |
| 6 | B250621 | 5.7 | 362 | 173 | 243 |
| 7 | B250623 | 5.9 | 512 | 241 | 343 |
| 8 | B250626 | 5.8 | 685 | 329 | 453 |
| 9 | A250501 | 11.8 | 66480 | 38720 | 44520 |
| 10 | A250505 | 0.3 | *out of range* | *out of range* | *out of range* |

### Produced dairy water's flux values

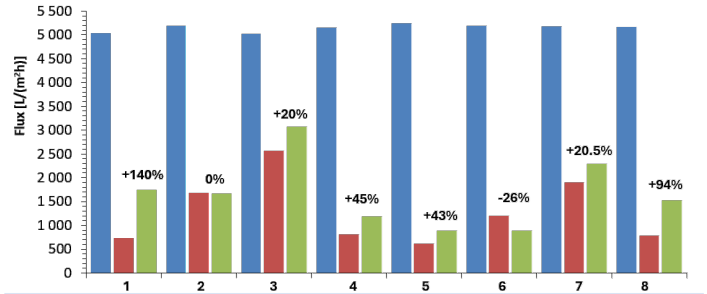



### Model dairy water's flux values

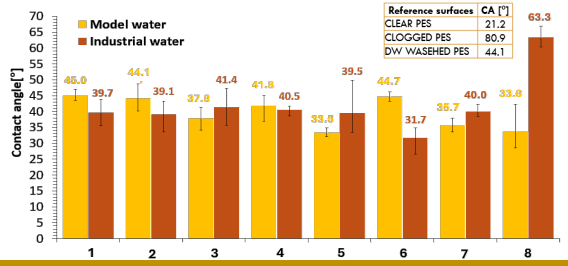



| A250501 Recovered flux [L/m²h] |
|---|
| 4564.2 |
| 4764.8 |
| 4710.0 |
| 4735.4 |
| 4626.8 |
| 4633.0 |
| 4432.8 |

| A250505 Recovered flux [L/m²h] |
|---|
| 2682.0 |
| 2822.8 |
| 3106.0 |
| 3334.8 |
| 3533.4 |
| 3602.6 |
| 3701.0 |
| 4196.0 |
| 4220.0 |
| 4444.2 |




### Contact angles of fouled membranes after chemical cleaning




| Reference surfaces | CA [°] |
|---|---|
| CLEAR PES | 21.2 |
| CLOGGED PES | 80.9 |
| DW WASEHED PES | 44.1 |

## IV. CONCLUSION

- Two kind of detergents were investigated with increasing concentration (No. **1-4** and No. **5-8**) as well as alkaline and acidic detergents (No. **9-10**);
- The alkaline agent cleared the pores faster and more efficiently than the acid;
- The chemical No. **1** cleaned the pores the most in both cases (PES MF fouled with model and real whey water) – fouled flux values increased 2.5 times;
- In the case of fouling with real whey water detergent No. **3** was similarly effective (flux increased 2 times);
- Detergent No. **2** had no effect on a membrane fouled with model water, but it was effective for cleaning real water from the pores (1.85 times higher flux);
- Depends on a contact angle measurements, the investigated detergents exerted their effect in the pores rather than on the surface: CA results are similar with distilled water washed membranes surface, but the fluxes were increased after chemical treatment – so pores cleared in varying degrees.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