



Electrical Pulse Oxidation Process (EPOP) – an alternative pre-treatment for soil-aquifer treatment in indirect potable reuse

What is EPOP?

- High voltage electrical pulses combined with oxygen gas are being discharged through multiple hollow electrodes
- Formation of radicals (OH*) and other strong oxidants
- Generation of ozone as a secondary oxidant

Application case and expected benefits

- Treatment of secondary effluent after bio-filtration in the Shafdan water reuse site (Figure 1)
- Reduction of trace organic contaminants
- No or minimal disinfection byproducts (DPBs) formation

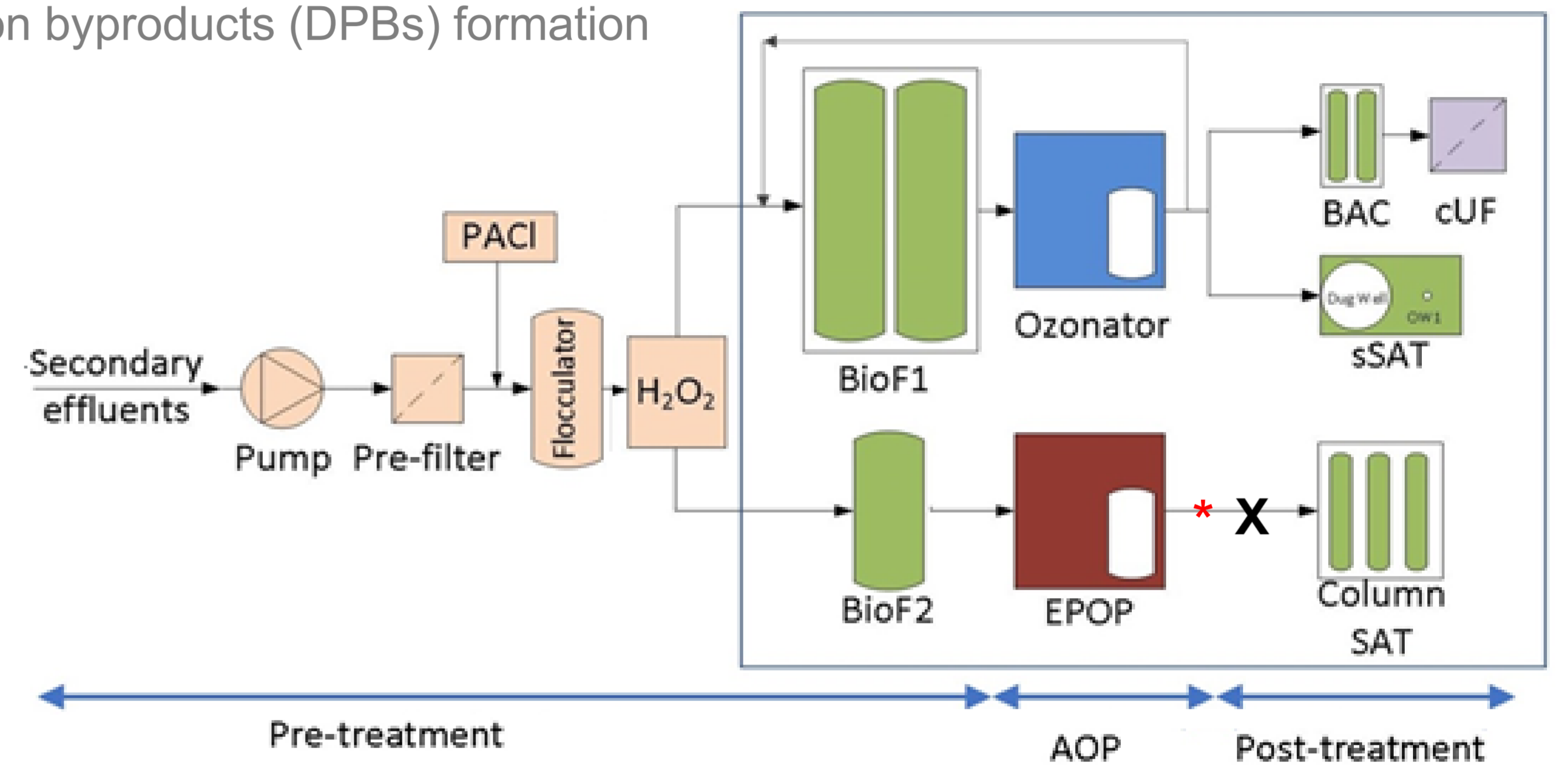
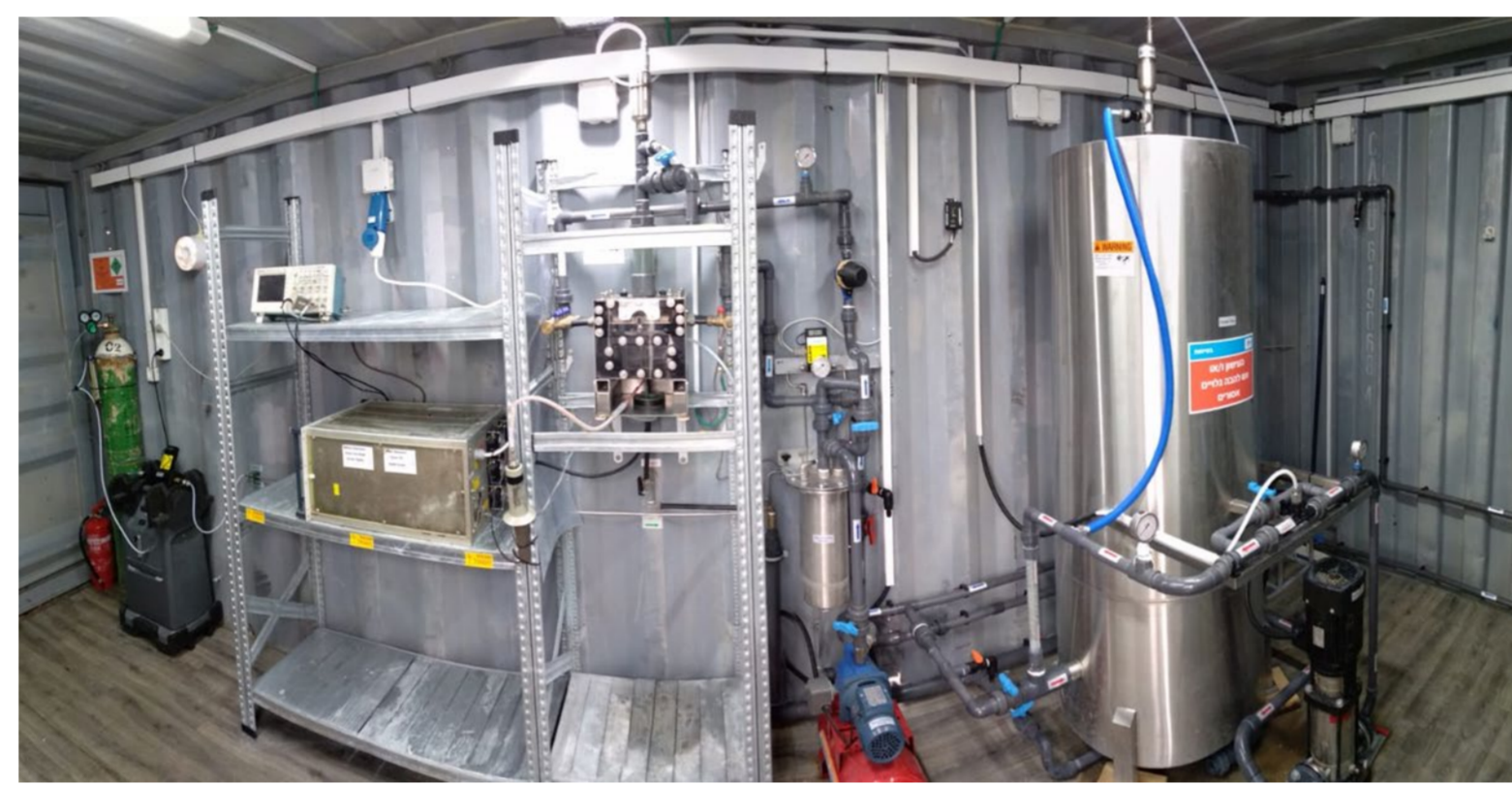


Figure 1: Scheme of the Shafdan demonstration site
* SAT Column and BAC UF were not connected

Technical demonstration

- Effluent Feed : 0.6-3 m³/h, oxygen feed: 10-30 LPM
- Laboratory and field measurements of UVA₂₅₄, 0.45 μm filtered UVA₂₅₄, DOC, DO, NH₄, NO₂, NO₃, TrOCs, NDMA, BrO₃, microbiology and toxicity
- Power consumption of 1.5 to 2.5 kWh/m³



Figure 2 EPOP system

Results

EPOP Effectively removed various micro-pollutants and microbiological parameters:

- 0.45μm filtered UVA₂₅₄ reduction of 40%-67% (Figure 3)
- TrOCs removal of 80%-100% (Table 1), (Figure 4,5)
- Microbiological full reduction (Table 2)
- Results are before EPOP treatment and after EPOP treatment (No SAT Column or BAC UF)

| Date | Sampling Point | TrOCs (@TZW unless otherwise specified) | | | | | | | | | |
|---------|-----------------------|---|-------------|--------------|-------------|-------------|------------------|-------------------|-------------|--------------|-----------|
| | | CBZ ng/L | BZF ng/L | IPRM ng/L | SMX ng/L | DCF ng/L | Naproxen ng/L | Ibuprofen ng/L | IHX ng/L | IPDL ng/L | % removal |
| 12.2.19 | Secondary effluents | 460 | 120 | 8000 | 120 | 870 | 560 | 150 | 36000 | 18 | |
| | WADIS filtration tank | 510 | 230 | 9300 | 220 | 840 | 700 | 570 | 24000 | 22 | |
| | WADIS product tank | 0 | 0 | 1700 | 0 | 0 | 0 | 17 | 6600 | 0 | |
| | % removal | 100% | 100% | 82% | 100% | 100% | 100% | 97% | 73% | 100% | |
| 19.2.19 | Secondary effluents | 550 | 120 | 11000 | 150 | 900 | 630 | 220 | 41000 | 42 | |
| | WADIS filtration tank | 600 | 150 | 7400 | 170 | 1100 | 650 | 310 | 31000 | 36 | |
| | WADIS product tank | 61 | 17 | 8700 | 12 | 16 | 15 | 140 | 36000 | 30 | |
| | % removal | 90% | 89% | 0% | 93% | 99% | 98% | 55% | 0% | 17% | |
| 26.2.19 | Secondary effluents | 730 | 94 | 7500 | 200 | 1400 | 510 | 160 | 26000 | 30 | |
| | WADIS filtration tank | 790 | 110 | 6400 | 250 | 1600 | 590 | 230 | 25000 | 27 | |
| | WADIS product tank | 150 | 17 | 4700 | 110 | 260 | 75 | 95 | 18000 | 28 | |
| | % removal | 81% | 85% | 27% | 56% | 84% | 87% | 59% | 28% | 0% | |
| 5.3.19 | Secondary effluents | 750 | 450 | 9400 | 250 | 1200 | 590 | 220 | 31000 | 71 | |
| | WADIS filtration tank | 640 | 360 | 9300 | 210 | 990 | 600 | 310 | 27000 | 47 | |
| | WADIS product tank | 83 | 54 | 3600 | 40 | 130 | 67 | 81 | 5100 | 22 | |
| | % removal | 87% | 85% | 61% | 81% | 87% | 89% | 74% | 81% | 53% | |
| 12.3.19 | WADIS filtration tank | 690 | 250 | 6800 | 200 | 1000 | 740 | 140 | 20000 | 32 | |
| | WADIS product tank | 0 | 0 | 130 | 0 | 0 | 0 | 0 | 580 | 0 | |
| | % removal | 100% | 100% | 98% | 100% | 100% | 100% | 100% | 97% | 100% | |
| 19.3.19 | Secondary effluents | 710 | 290 | 12000 | 200 | 1100 | 510 | 160 | 40000 | 74 | |
| | WADIS filtration tank | 710 | 250 | 10000 | 230 | 1100 | 670 | 190 | 32000 | 74 | |
| | WADIS product tank | 0 | 11 | 4700 | 0 | 0 | 0 | 0 | 17000 | 36 | |
| | % removal | 100% | 96% | 53% | 100% | 100% | 100% | 100% | 47% | 51% | |

Table 1: TrOCs Removal, Average flow rate: 2 m³/h, Average power consumption: 1.8 kWh/m³

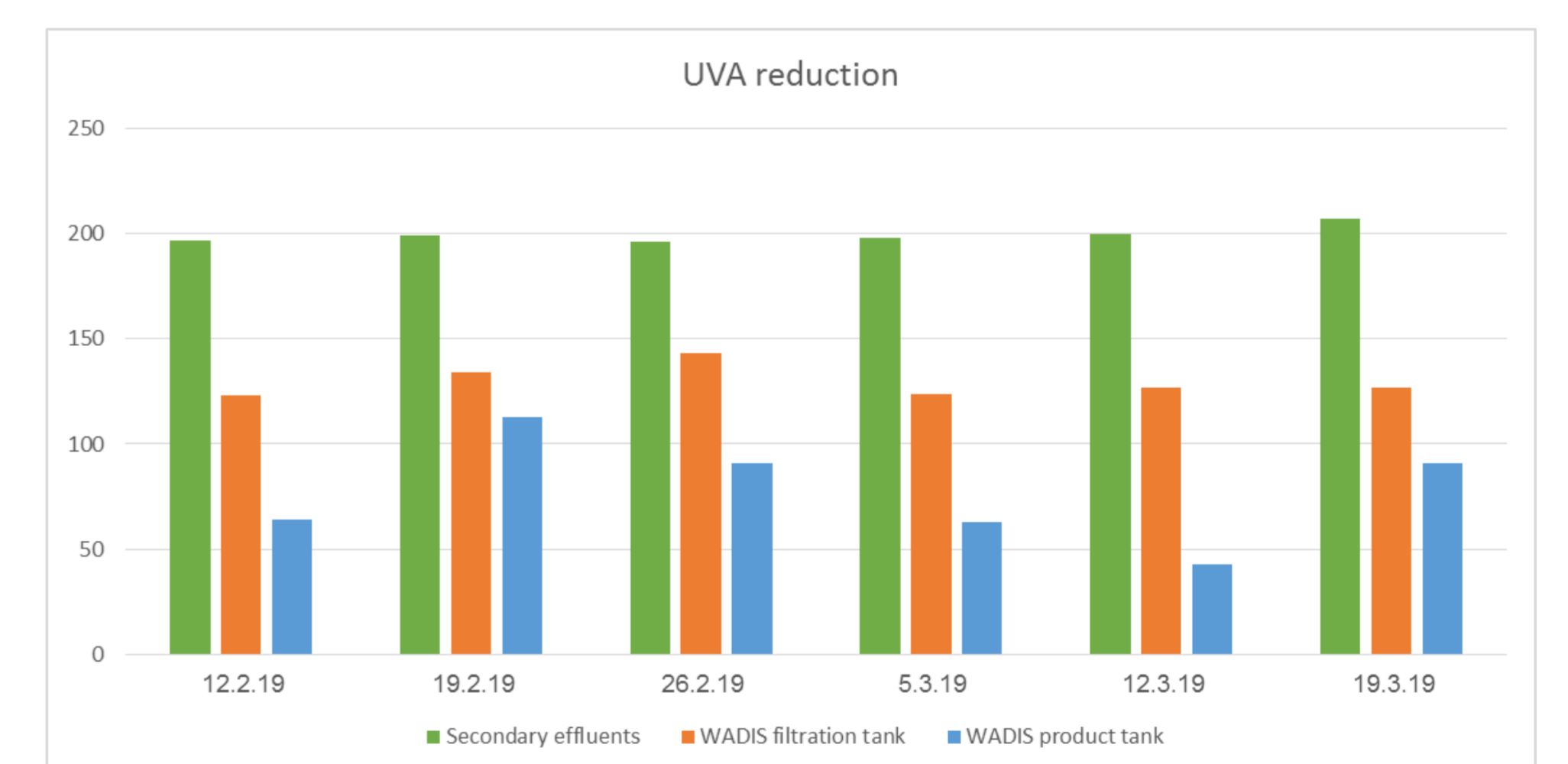


Figure 3. 0.45μm filtered UVA₂₅₄ reduction

Conclusion

- WADIS EPOP system reached satisfactory results more than expected for the parameters tested although not in its final operation capabilities
- Further developments will insure even better results

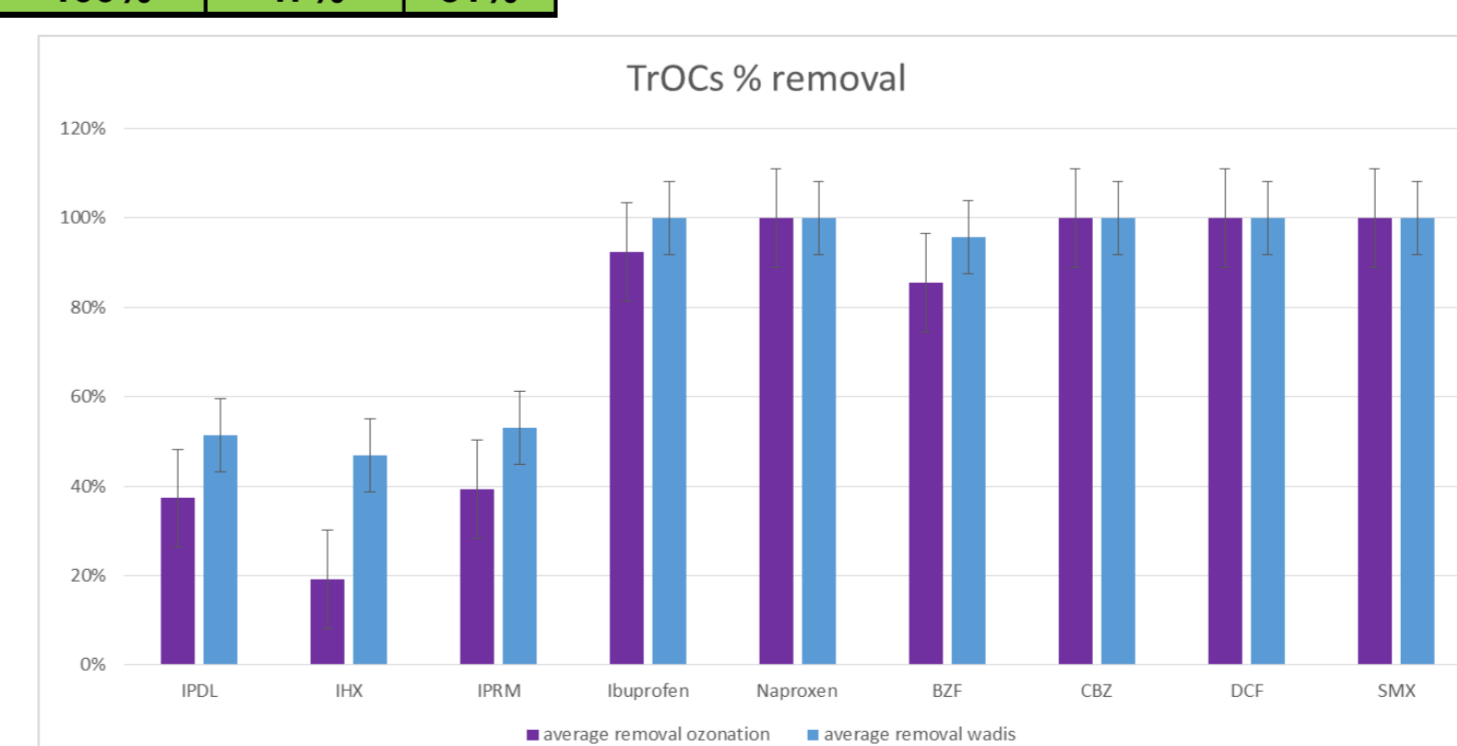


Figure 4 TrOCs comparison EPOP to Ozonation 19.3.19

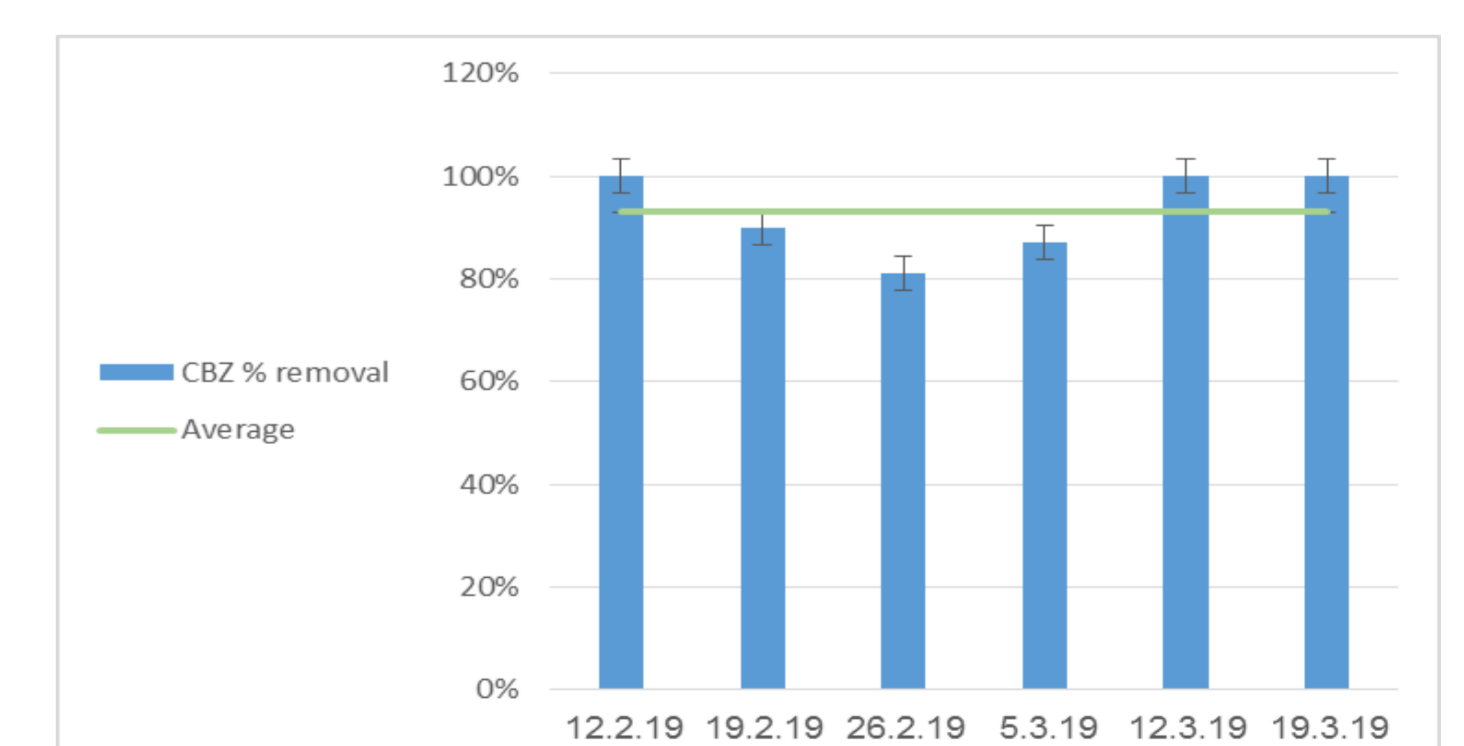


Figure 5. CBZ Removal

Contact

WADIS Ltd.
3 Golda Meir Str. Science Park,
7403648 Nes Ziona, Israel
T +972-8-9313010
www.wadis-co.com

| Sampling Point | Total Bacterial Count | Coliform | Fecal Coliform | Fecal Streptococcus | GIARDIA | CRYPTOSPORIDIUM |
|----------------|-----------------------|----------|----------------|---------------------|---------|-----------------|
| Control | 6600 | 1700 | 33 | <1.8 | 0.80 | 0.40 |
| OZONATION | 70000 | 79 | 5 | 0 | 0 | 0 |
| % removal | 0% | 95% | 85% | ND | 100% | 100% |
| WADIS | 120 | 0 | 0 | 0 | 0 | 0.6 |
| % removal | 98% | 100% | 100% | ND | 100% | 0 |

Table 2 microbial comparison EPOP to Ozonation 19.3.19

