

INTEGRATED MICRO-SCREEN AND ULTRA-FILTRATION SYSTEM FOR PALM OIL MILL EFFLUENT (POME) POLISHING TREATMENT

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Palm oil mill effluent (POME) has high soluble and insoluble organic materials, which contribute to its high Biological Oxygen Demand (BOD) content, thus, posing a challenge in treating it. More challenges are anticipated if the limit of BOD level below 20 ppm were to be imposed by the Department of Environment. Currently, the industry is applying the conventional tertiary/polishing treatment as an additional step after the secondary treatment (biological) to treat POME. However, most of the tertiary/polishing treatments fail to achieve the BOD 20 ppm consistently. This was due to high insoluble BOD content in POME contributed by suspended solids (SS) that are difficult to be degraded during the biological treatment. This problem can be tackled by introducing the combination of micro- and ultra-filtration technology to maximise the simultaneous removal of the SS and insoluble BOD from the POME. The integration of micro-screen and membrane ultra-filtration system will reduce the insoluble BOD by removing both large and fine solids from digested POME. New filtration media, which is a stainless steel micro-screen filter replaces the conventional clarifier system to enhance solid removal after the biological treatment. At this level, using the right type of chemical and dosage, the system is able to remove SS from the influent at a minimum of 80% and consequently reduce the BOD by 20%. Effluent from the micro-screen filter is further treated in the membrane ultra-filtration system to remove the remaining fine solids. This reduces the BOD and SS with a minimum of 90% removal.

INTEGRATED FILTRATION SYSTEM

Many palm oil mills experience high SS content in the treated POME. High SS leads to high BOD in the final discharge. Removal of SS will reduce the BOD. A combination of micro- and ultra-filtration technology to further polish the treated POME received from biological treatment in the

secondary ponding system was developed. This polishing treatment brings down the SS and BOD to ≤ 20 ppm before discharge. The integrated filtration system consists of two stages.

Stage 1: Micro-screen Filtration System

The micro-screening filtration system (*Figure 1*) removes solid particles larger than 65 micron from the POME. To make the solid system efficient, POME was subjected to coagulation and flocculation treatments to enlarge the solid particles for separation using the micro-screening filter. The pre-determined chemical dosages with proper mixing time produce filterable solid particles for easier separation. The interchangeable stainless steel filters with various screen sizes of 65 to 125 micron are resistant to chemicals, heat and corrosion. The unique self-cleaning mechanism is operated using a pneumatic system that avoids the screen from clogging using water sprays. This makes the system operates continuously and with minimal manpower.

Stage 2: Membrane Ultra-filtration System

Membrane ultra-filtration (*Figure 2*) is capable of removing the remaining fine SS (less than 1 micron) that are not removed by the micro-screen. This system uses the latest polyvinylidene fluoride (PVDF) membrane modules with outside and inside filtration technology (*Figure 3*). PVDF membrane is selected for its resistance to chemicals, high mechanical strength and ease in cleaning. The membrane ultra-filtration process is designed with the correct flux rate and fully automatic *in situ* cleaning facilities, making it highly efficient, less fouling and easy to operate.

CHARACTERISTICS OF FINAL POME DISCHARGE FROM THE INTEGRATED PLANT

From a pilot plant trial, the system is able to treat POME from the secondary pond with BOD < 500



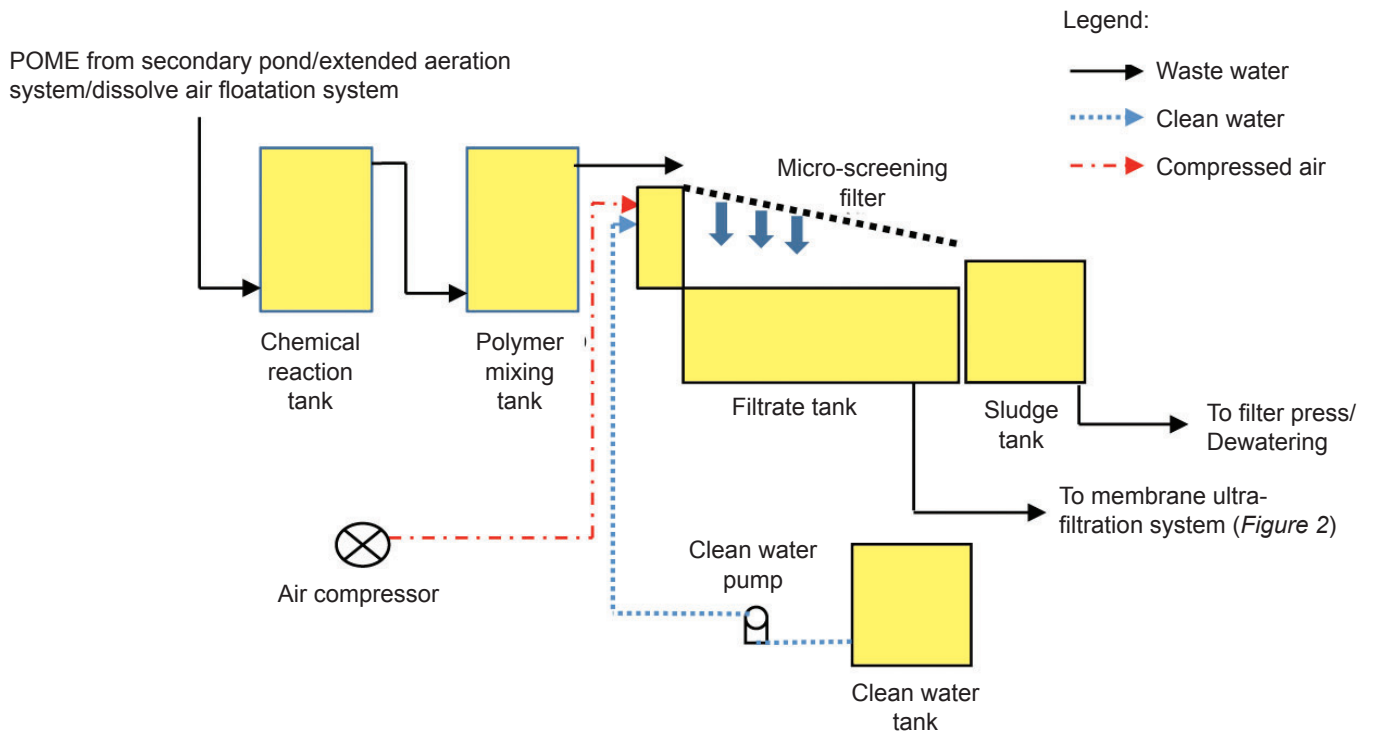


Figure 1. Schematic diagram of a micro-screening filtration system plant.

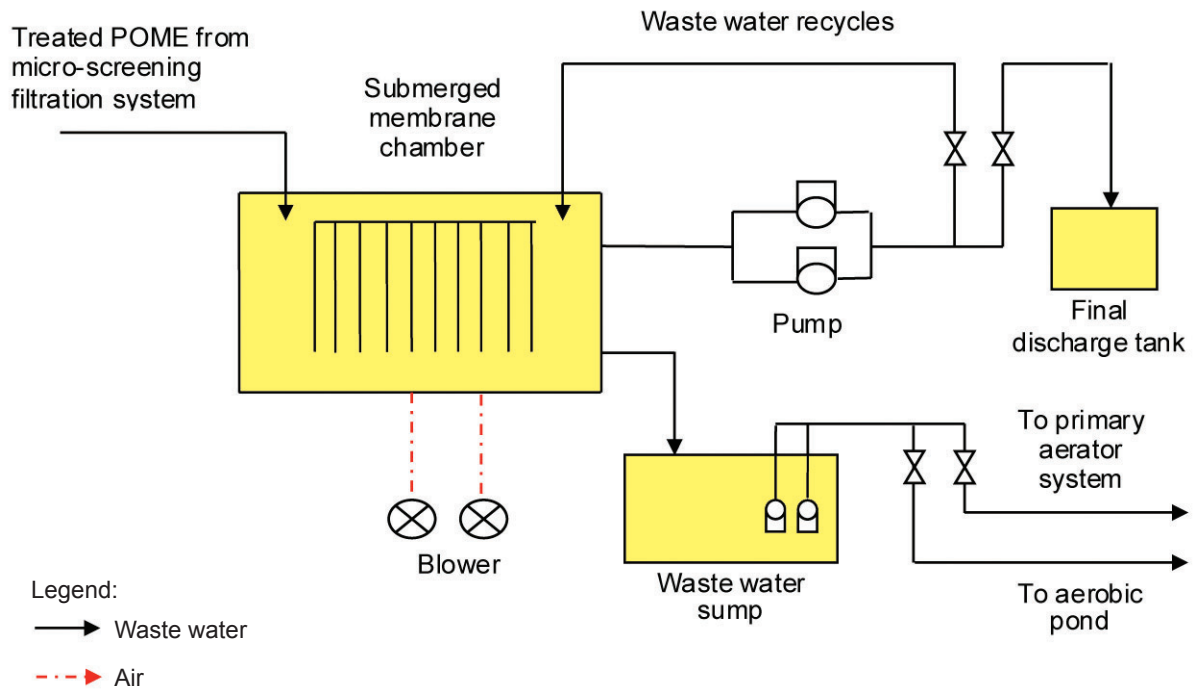


Figure 2. Schematic diagram of an ultra-filtration membrane system plant.

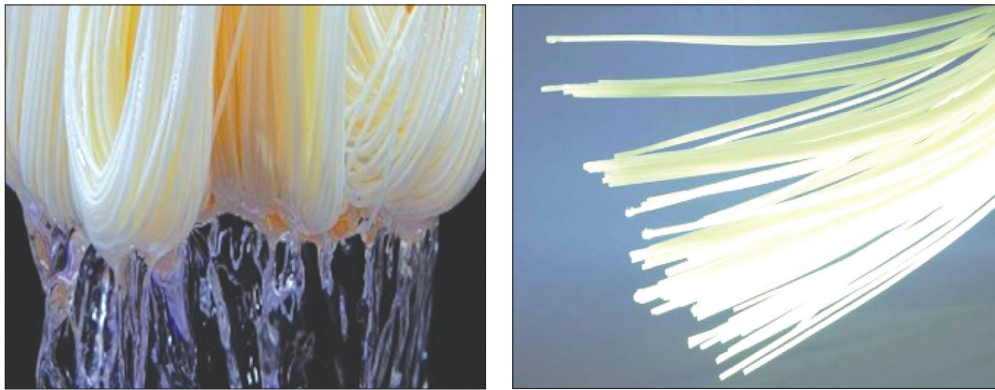


Figure 3. Polyvinylidene fluoride hollow fibre membrane.

ppm with final discharge below 20 ppm (Table 1). Overall Chemical Oxygen Demand (COD) and SS reductions are 88% and 96%, respectively. The physical appearances of POME samples from micro-screen and ultra-filtration treatment are shown in Figure 4.

BENEFITS

The benefits of these systems are: it is automated, self-cleaning with low volume of clean water and able to run 24 hr with minimum labour.

PLANT COST

For the integrated polishing plant, with typical POME discharge of 45 m³ hr⁻¹, the estimated capital cost for both micro-screening and ultra-filtration is about RM 2.5 million. However, the configuration of the system can be different for each mill depending on the existing POME treatment system.

Interested parties are welcomed to test-run the system at the MPOB Palm Oil Mill Technology Centre (POMTEC), Labu, Negeri Sembilan.

TABLE 1. CHARACTERISTICS OF PALM OIL MILL EFFLUENT (POME) SAMPLES FROM THE INTEGRATED PLANT

POME	BOD (ppm)	COD (ppm)	SS (ppm)
Feed to micro-screen	<500	3 530	1 613
Feed to ultra-filtration membrane	<200	1 357	632
Final discharge	10.7	410.4	54.2



Figure 4. Palm oil mill effluent samples: (a) before and after micro-screening filtration; (b) after membrane ultra-filtration.

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