20 questions (mostly related to MBR)

1. How do you maintain an even distribution of air to the membranes? How to evaluate the evenness of airflow across the membrane area?

Good distribution can be achieved through well planned pipe work size and routing, use of valves, and regular inspection with back flushing of the pipes if necessary. Membrane inspection during soaking to determine localised build up of sludge will highlight areas that may require attention.

2. For effective aeration, is it better to use large bubbles or fine bubbles?

Large bubbles (3mm) are more effective than fine bubbles for scouring the membrane surface of fouling materials. However, the oxygen transfer efficiency is much reduced compared with fine bubbles.

3. How often do you need to clean the membranes?

Backwashing of the membranes with water (in situ) is recommended every 3 months and external soaking of the membranes in appropriate chemicals annually. These frequencies will depend on a number of factors including the nature of the wastewater, the MLSS concentration, and efficiency of aeration scouring.

4. Is it necessary to use chemicals to backwash? Will this affect bacterial performance?

It is recommended that chemicals NOT be used for in situ backwashing because the contact of oxidising chemical may have a negative effect on the bacteria performance within the biological system. However, if in situ backwashing using water provides minimal improvement to membrane flux, then a low concentration of appropriate chemical may be required.

5. How long does membrane cleaning take?

In situ backwashing using water is carried out by pumping water through the membrane in reverse mode for 3 to 5 minutes then the backwash pump stopped. After 5 minutes, the same sequence is repeated over a period of up to 60 minutes. External membrane soaking takes up to 24 hours for each set of membranes.

6. What is the expected life of the cassettes?

The membrane cassettes are made of stainless steel and are expected to last as long as the system if they remain undamaged and handled carefully during lifting in and out of the MBR tank..

7. What are the guarantee details of the membranes?

The membrane guarantee is 3 years, subject to correct handling by the operator...

8. How many CMF/MBR projects do you have in operation? Sizes, types of wastewaters, etc.

See Project Experience of web site.

9. What pollutants affect membranes most?

Oils, particularly mineral oils; solids >5mm in MBR raw water, & solids >0.5mm diameter for feed water to CMF systems. MF and UF membranes are also susceptible to some coagulating metal salts, such as iron and aluminium, and colloidal material. All pollutants should be reduced or removed form the water to be treated to avoid membrane damage or deterioration.

Another common cause of membrane fouling is SMPs (soluble microbial products) which are generated by bacteria under certain environmental conditions of biological degradation. Membrane exposure to such conditions should be minimised.

10. What is the minimum monitoring that should be carried out to ensure good system performance? On-line and off-line?

An MBR system comprises biological and physical systems which require different types of monitoring to measure system performance. CMF also requires physical, chemical and biological monitoring during system performance. Please refer to "Monitoring Recommendations" of the web site

11. What are the most common factors for failure of CMF/MBR systems?

Some factors that may lead to inadequate performance of membrane based systems include:

- Inaccurate design data vs actual feed conditions.
- Inadequate pre-treatment systems
- Inadequate attention to critical operational parameters such as TMP, temperature, flow & flux
- Lack of attention to the microbial community composition and environment.
- Poor equipment selection,

12. Can the membranes really retain all bacteria? What happens when membrane strands break?

The average membrane pore size is 0.2µm which is smaller than bacteria. Thus all bacteria are retained as long as the membrane remains intact. If a membrane strand breaks, the presence of small particles in the feed water will eventually block the end of the fibre and seal the break. This happens almost instantaneously in the MBR where high particle concentrations will rapidly block any broken fibre ends.

13. What is the maximum flux of the membranes?

The maximum flux through Motimo hollow fibre membranes depends on the type and concentration of the wastewater being treated. Pure water flow in a MOF1616 module is 6500 – 8000L/hour,,& when treating secondary clarified effluent reduces to 2000L/hr. The FP-1A MBR flat plat has a pure water flux of 500L/hour, & in domestic wastewater, the average flux reached is around 12LMH. This is an average flux on which the system is designed, including non-product flow periods, and the instantaneous flux may reach twice this level.

14. What membrane material do you use? Why? What are the benefits/disadvantages?

Motimo membranes are manufactured from PVDF (Polyvinylidene fluoride), a high strength material with excellent heat resistant properties optimum operation is 5-45^{o}C), low surface energy which thus reduce fouling, chemical stability, radiation-resistance and good physical and mechanical performance.

15. What is the optimum/maximum/minimum MLSS that is recommended for the MBR process?

A recommended MLSS level is in the range of 8,000 to 10,000mg/L. Above 10,000mg/L there is an enhanced risk of fouling of the membranes and additional power is required to pump sludge where recirculation is required. Below 8,000mg/L the system is not utilising its full advantage in achieving biodegradation of difficult wastewaters.

16. What are the temperature limits for the process to operate?

The recommended temperature range for optimum operation of Motimo PVDF membranes is 5-45^{o}C. There is a gradual decrease in flux with decreasing temperature because of the increased viscosity of the liquid.

17. Is it better to have a single MBR tank or several tanks?

The choice of one tank or several tanks depends on a number of factors. In smaller MBR systems, the size of the membranes and cassette limits the tank to a single tank to maintain a reasonable HRT. An additional anoxic/anaerobic tank may be required up front if total nutrient removal is required. In larger MBR systems, the separation of membrane tanks is advantageous to isolate membrane units for

washing purposes, and also to control the air flow rates in different parts of the system. Use of coarse bubbles beneath the membranes helps control fouling. Fine bubbles are required to provide sufficient oxygen for degradation of wastewaters, particularly where BOD is high, and this form of aeration could be incorporated into a separate tank designed for biological oxidation, thus allowing finer control of the processes taking place and identifying limiting factors. If sequenced implementation of the MBR system is required, for example in the case of low wastewater flows at start up, separate tanks provide significant flexibility in operation and thus in power consumption costs. A disadvantage of separate tanks is extra costs in pumps and monitoring. The design for separate tanks is therefore a combination of the water quality standards required, power cost differences and the degree of flexibility required.

18. What is maximum inflow NTU value for our CMF systems? At what point do you need pre-filter? Is it just a question of flux – reduce flux and you can increase influent NTU?

We should recommend pre-filtration down to 200micron

19. Can the MBR be operated under gravity e.g. from an overhead tank?

In theory, providing the pressure is sufficient, a water tank may be placed above the membranes and water will flow through the membranes by gravity. Backwashing would have to be done manually e.g. by reversing the membrane and again using gravity pressure to allow clean water (product water) to flow through the membrane pores.