Introduction

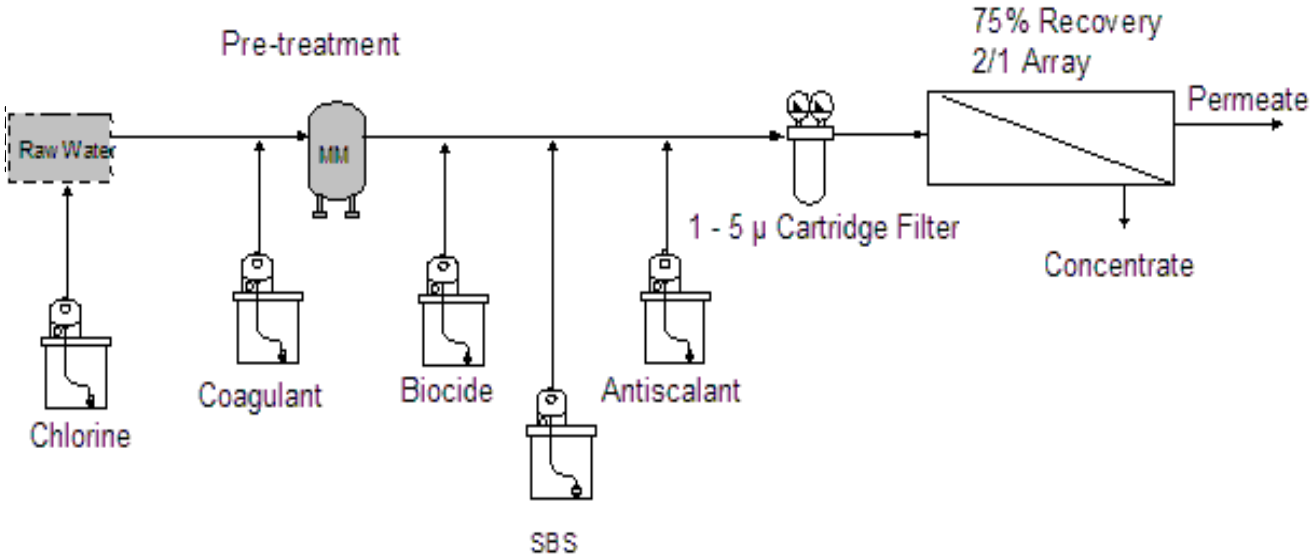
Dosing chemicals into membrane treatment systems is essential for efficient and effective operation. Dosing the correct chemical at the optimum rate and in the most effective manner will ensure long-term plant performance is optimised. The following describes the chemicals commonly dosed into membrane systems and provides advice on where the products should be injected into the process. It also outlines what parameters should be taken into account when designing a dosing set.

Typical Dosing Regime

In a typical membrane plant the following chemicals are applied:

- Chlorine (often in feed)
- Coagulant
- Acid (occasionally)
- De-chlorination
- Biocide
- Antiscalant

The diagram below shows a typical plant flowsheet with chemical dosing positions shown. To obtain good chemical mixing dosing points should be installed into zones of turbulent flow, eg., pipe bends, pumps, filters. If this can be achieved static mixers are not generally required.



Chlorine Dosing

Chlorine is normally dosed in the feedwater to ensure no bacterial growth occurs. This may be in the form of liquid chemical or generated in-situ by an electrochlorination unit. Chlorine is not compatible with polyamide membranes and therefore has to

be removed before it can reach the membranes.

Coagulant

Where multi-media filters are included coagulants or flocculants are dosed to improve the removal efficiency of sub micron particles. Avista Technologies RoQuest range of coagulants can be dosed just upstream of the filtration device as the residence time in the filter dome is adequate to allow coagulation to occur.

Coagulant dose rate is determined on site and may vary with the season if the water quality changes. Dosing system design should have as much flexibility as possible. Avista Technologies can carry out jar tests during the project design phase to provide guidance on dose rate required as well as providing guidance on the optimisation of dose rate on site during commissioning and operation.

Anti-Chlor

Dechlorination is often achieved by the dosing of sodium bisulphite (SBS). Dose rate should be 1.5 – 2 times the level of chlorine in the feedwater. The SBS can be dosed anywhere into the feed system but is normally dosed either upstream or downstream of the feed cartridge filters. It is wise to include a REDOX meter to ensure that adequate SBS is being dosed and there is no residual chlorine in the feed.

Biocide

Biocide can be applied constantly where chlorination of the feed is not present. In this case the biocide should be dosed as close to the intake point as possible.

If the biocide is to be dosed intermittently it should be dosed upstream of the dechlorination point to ensure there are no unprotected lengths of pipe in the system. It should be noted that RoCide DB5/20 will affect any REDOX meter downstream although it will not damage the membranes.

Suggested biocide dosing, and effectiveness monitoring regimes are provided by Avista on request.

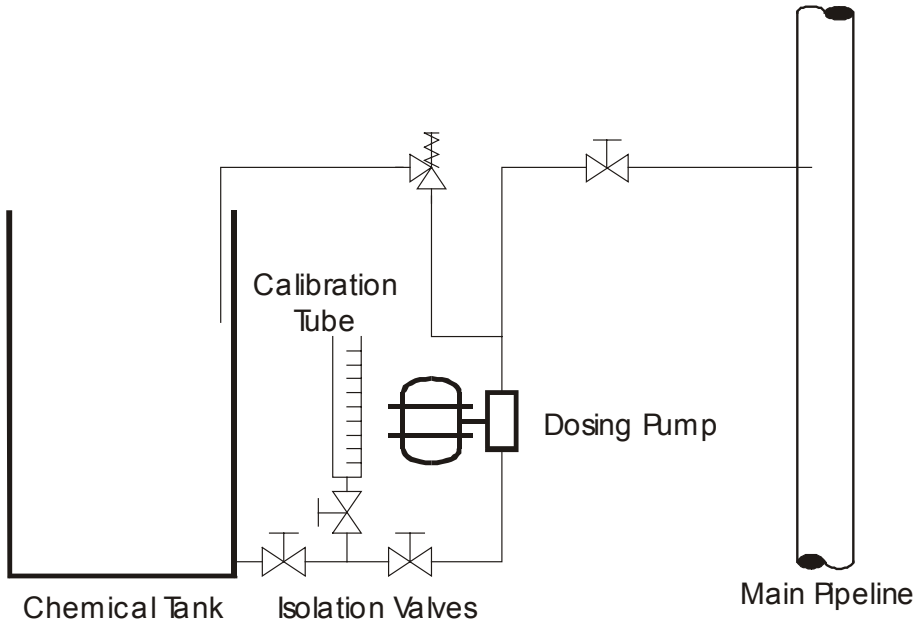
Antiscalant

In the reverse osmosis process dissolved salts are concentrated due to the permeation of water. This normally results in salts exceeding their solubility limits and an antiscalant is therefore applied to the feed water to chelate these salts and prevent scale precipitation within the membrane system. If antiscalant is not continuously applied, scale crystals will rapidly form, which will reduce the permeate production flowrate, increase salt passage and potentially damage the membranes.

Calculating the correct dosage of antiscalant is best done using dedicated computer software. Avista Technologies supply customers with the Avista Advisor, which uses system details such as the raw water analysis and system recovery to accurately calculate the required level of antiscalant.

Antiscalant is normally dosed just upstream of the system cartridge filters to allow good mixing prior to the membrane system. In systems where sulphuric acid is dosed as well as antiscalant ensure that there is as much distance between dosing points as possible. Contact between concentrated acid and antiscalant will deactivate the antiscalant.

Figure 1: Typical Chemical Dosing System



Chemical Dosing System Design Considerations

Figure 1 shows a typical arrangement for a chemical dosing system. The following are the main components of a system.

Dosing Tank

The dosing tank should be sized to hold sufficient chemical for the system to operate between regular maintenance checks. Most membrane systems are monitored at least daily, therefore these tanks could theoretically be sized to hold 24 hours supply. However, providing good housekeeping is practiced, the chemical may be stored in the tank for many weeks without detriment to the chemical or its effectiveness.

The tank should be provided with a close fitting lid to prevent dirt ingress to the tank. Overflows and drains should be directed to the chemical waste system, or to a bund from which any waste can be handled correctly. The most common materials for the tanks are plastics, particularly high-density polyethylene.

If the sizing of the dosing pump has necessitated the dilution of the chemical, the tank should permit some method of mixing the antiscalant with the dilution water. A hand operated paddle mixer is the most normally employed, as the required mixing energy is very low and once fully homogenised the solution will not separate and therefore will not require further mixing.

Dosing tanks should be maintained in a clean condition. This is especially important where dilute chemical is applied and it is suggested that the dosing tank is cleaned out every 6 months to prevent bacterial growth. Alternatively, a preservative could be added to the solution. Please contact Avista for further guidance.

Dosing Pump

The dosing pumps should be sized to allow the specified dose at between 40 - 80% of the capacity of the pump. This will allow

the dose rate to be increased should the water quality change, and it is necessary to change the dose rate. The majority of membrane systems operate at constant or near constant flow rates, and therefore most chemicals are dosed at a fixed rate. If the flowrates are to vary by more than 20%, then it may be necessary to vary the dosing rate with the flowrate to the membrane system.

The dosing pump should be designed to give as smooth a flow of chemical to the plant as possible. With positive displacement dosing pumps regular pulses of chemical are preferred - generally the pulse should operate at an absolute maximum of 5 second intervals.

Care needs to be taken to prevent siphoning of the chemical tank contents during dosing pump shutdown periods.

Mixing

It is not normally necessary to make special arrangements for the mixing of antiscalants, coagulants, biocides or mineral additives into the main process stream as all are very miscible with water. Avista Technologies recommends a series of bends (which are incorporated into the design for other purposes) as a method of creating the small amount of turbulence required to mix the chemical.

Calibration Tube

Although a good approximation of the dosing pump delivery rate can be made by reference to the pump curve, it is strongly recommended that a calibration tube is fitted to the suction side of the pump to allow the dose rate to be calculated exactly.

Dosing errors occur when chemical feed pumps are not calibrated correctly and when calculation errors are made. The Avista Advisor software calculates the required dosing pump rate and provides details to allow you to make up dilute solutions.

Recommended Materials of Construction

In general Avista dosing chemicals are compatible with polyethylene and polypropylene. If metallic construction is required 316SS is generally an acceptable material for all products except RoCide DB5/20. For specific advice on materials for online or intermittently used chemicals please contact Avista.

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