DESALINATION - A GROUND FLOOR PERSPECTIVE FROM AN OPERATOR

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OVERVIEW OF DALBY WATER SUPPLY

Dalby is a small but vibrant country town with a population around 10,000 people. Water consumption can vary from 3 megalitres per day to 11 megalitres per day.

Water supply consists of the following:

- 10 shallow bores (about 25 metres) which produce approximately 3.5 megalitres per day. The yield from these bores is depleting continuously.
- Condamine River, from which we can treat 2 megalitres in an 8 hour shift, but because we depend on rainfall to fill the weir, this is unreliable.
- Desalination plant which produces 1.7 megalitres per day from deeper, but higher yielding, saline bores (about 55 metres).

After basic treatment this water is blended, pH corrected, chlorinated and fluoridated before being sent to storage reservoirs.

1.0 START OF DESALINATION AS A CONCEPT

Obviously, without the desalination plant, more water was needed to help satisfy demand in hot, dry periods and at times when river water is not available.

Figure 1: ***Pilot Plant***

In 2002, a small 6 litre per minute pilot desalination plant was set up, accompanied by a fair amount of monitoring and recording, to assess potential treatment of saline ground water to augment the town's water supply.

When it became evident that desalination was an option, Council's Technical Supervisor went on a two week study tour in the United States of America to view desalination plants, obtain operating data, discuss operational and maintenance practices, identify advantages and disadvantages of different plants, which helped with the design of the current plant.

Dalby Town Council then decided to proceed with desalination as an additional water source.

In 2004, after much planning and 2.8 million dollars, Dalby Town Council ended up with the first desalination plant of this size to be used by a local authority in Queensland.

Figure 2: ***Desalination Plant***

During the preparation of planning, I was wondering how I was ever going to learn to use this technology.

Being exposed to words such as strontium, barium and molybdate reactive silica was a bit of a shock to me, being an operator with limited experience and very limited technical knowledge.

2.0 BASIC DESALINATION PLANT OPERATION

Our desalination plant uses reverse osmosis technology, where saline water is forced through spiral wound membranes that are not permeable to salt, so the end result is one stream of non saline water (permeate) and one stream of highly saline water (concentrate).

As the membrane pores are extremely small (one thousandth of one micron) not much else escapes through except pure water.

The Desalination Plant is fed by 3 bores to a manifold where a feed pump boosts pressure. The water then feeds through media filters composed of gravel, sand and anthracite, and then dosed with antiscalant, then through 5 micron bag filters followed by 1 micron cartridge filters.

Figure 3: ***Media Filters***

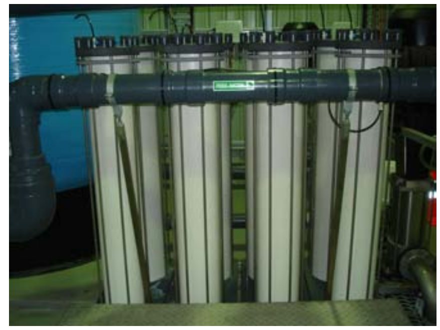

Figure 4: ***Cartridge Filters***

A systems pump then boosts pressure again, and the water then flows through the first array of 8 membrane vessels where 50% is taken off as permeate. Concentrate from the first array is then pressure boosted again by a boost pump, then runs through the second array of 4 membrane vessels, where 50% is again taken off as permeate.

Figure 5: ***Membrane Vessels – The Basis of Reverse Osmosis***

The end result is that we end up with 75% of total feed as permeate and 25% concentrate, which equates to 20 litres per second for the town water supply and 6.7 litres per second waste.

Permeate averages about 100 microsiemens and concentrate averages about 12,000 microsiemens.

The permeate is aerated to strip carbon dioxide, and dosed with caustic (sodium hydroxide) to correct pH, then fed to our clear water tank where it is blended with untreated bore water and treated river water, pH corrected, chlorinated and fluoridated, before being sent to storage reservoirs.

Two of the three feed bores are within thirty metres of the plant, which helped to reduce infrastructure and pumping costs.

The other bore was already connected to our water treatment plant, but was too saline to be used continuously.

Figure 6: ***Concentrate Disposal*** **Figure 7:** ***Evaporation Ponds***

Management of waste is an important part of desalination. As the concentrate is saline water it has to be disposed of in an environmentally friendly manner. The concentrate is pumped about 2 kilometres to 21 hectares of evaporation ponds, which are divided into two by 3.5 hectare ponds and two by 7 hectare evaporation ponds.

The waste main and pond structure are visually checked every day for leaks or potential problems. The waste main also has monitoring points spaced along the length at intervals for below ground manual sampling, to check for small leaks that cannot be seen from ground level.

We also have 6 monitoring holes spaced at intervals around the evaporation ponds to assess any potential groundwater contamination.

Figure 8: ***Data Logger***

Two of these monitoring holes are equipped with continuous testing and recording equipment, which is downloaded to a computer to check for trends in conductivity, pressure and temperature.

The other four monitoring holes are manually checked once per week. Environmentally friendly waste disposal is a major consideration when operating a desalination plant.

The Environmental Protection Agency was involved in the design of the plant and still has a close involvement with auditing, reporting etc. We have one whole manual devoted to procedures, strategies and contingency plans which relate to environmental protection. Waste disposal infrastructure is also a major capital cost, as our evaporation ponds cost around the $1,000,000 to build.

3.0 MAIN OPERATIONAL TOOLS

Monitoring for changes is our main operational tool.

Pressures, flows and water quality are monitored closely to assess potential problems. Membrane cleaning and filter changes are carried out according to trends in pressure, flow and conductivity throughout the plant.

Regular comprehensive feed water analysis is necessary as small concentrations of some chemicals can damage membranes or cause chemical scaling. We are fortunate in the fact that our feed water is fairly constant, and if there is a change, it is only gradual.

Anti-scalant dosing is very important with reverse osmosis, to inhibit chemical scaling of the membranes.

I have been told that anti-scalant to membranes is like oil to an engine – no anti-scalant and the membranes will rapidly choke.

To inhibit biofouling we dose with biocide at regular intervals.

The time needed to operate and maintain our plant would average about 3 hours per day. Council's Technical Supervisor was involved with the design and construction of our plant, which proved to be a great advantage as we have an operator friendly plant such as:

- Providing room to work on equipment for maintenance and monitoring.
- Simple things such as sampling taps in one location so daily samples can be collected quickly and easily; and
- All pumps can be maintained from floor level.

This may not seem to be a big deal but when working in the plant everyday it is greatly appreciated.

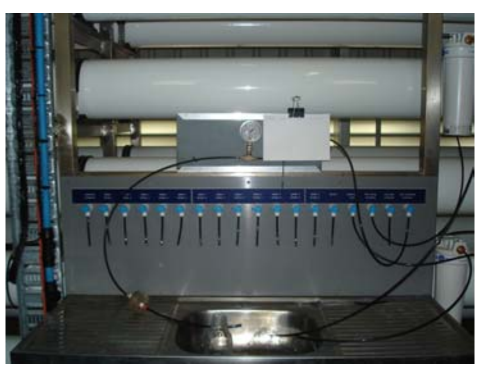

Figure 9: ***Sampling Taps***

4.0 CONCLUSION

Since desalination was first mentioned as a potential water source, our desalinated water production has progressed from producing five litres per minute to twenty litres per second and possibly 66 litres per second in the near future,

as Dalby Town Council is now planning to build another reverse osmosis desalination plant to treat coal seam methane water, which is a waste product from local gas fields.

As an operator of limited experience and knowledge, desalination posed many challenges and provided many learning experiences for me. In reality, mostly due to the excellent design and construction of the plant, I found that these challenges and learning experiences were exciting and rewarding.

If your local authority starts talking desalination, climb aboard and look forward to the experience.

5.0 ACKNOWLEDGEMENTS

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