

TARCUTTA TREATMENT PLANT IRON AND MANGANESE REMOVAL



Paper Presented by:

Peter Outtrim

Author:

Peter Outtrim, *Water Quality Officer,*

Riverina Water County Council



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ABSTRACT

This paper covers the upgrade to the Water Treatment Plant at Tarcutta village located on the Hume highway between Sydney and Melbourne.

The upgrade was necessary to achieve removal of soluble iron and manganese from the source water prior to chlorination of the village supply. The paper will essentially focus on the process which we went through to find suitable technologies for this removal.

KEY WORDS

DAF, Deferum, Polymer Floating Filter Media, catalytic.

1.0 Background

Tarcutta is a small village with a population of around 350 located on the Hume Highway approximately 400 km's south of Sydney. The village is supplied with "potable" water from two bores both of which contain high levels of soluble iron and manganese.

The original Tarcutta Treatment Plant was built in 1949 and apart from some minor upgrades had essentially remained unchanged. The plant is visited three times per week by an operator to undertake routine tasks which includes backwashing of the filters.

Plant capacity is 6 litres/second maximum output and backwash water consumes around 120 Kl per week, this is discharged to the table drain in front of the plant and then into Tarcutta creek.

One bore is located within the treatment plant yard with the other being several hundred metres south beside the creek. Iron levels entering the treatment plant range from around 15mg/L to 25 mg/L and manganese levels are stable at 0.5 to 0.6 mg/L.

Prior to the upgrade treatment included aeration followed by contact time and then sand filtration. The village water had not previously been chlorinated and the residents were generally very happy with the unchlorinated supply. Figure 1 shows a picture of the plant prior to commencing any work.

Following are the main reasons for undertaking the upgrade.

- Commence disinfection.
- Manganese removal.
- Decommission old inefficient filters and aeration towers.
- Replace ageing infrastructure.
- Discharge wastewater to a suitable source.
- Reduce iron solids loading on the existing filters.



Figure 1: *Tarcutta water treatment plant*

2.0 DISCUSSION

The initial stage of the project commenced early in 2005 and involved filling a 200 litre drum with bore water and adding varying amounts of hypo to see what type of reaction we got. At around 10mg/l hypo dose an iron based floc formed in the bucket. Jar testing was then commenced and after some fiddling we worked out a regime which seemed to work. So in theory it seemed simple, kill two birds with one stone, oxidation of all iron and manganese with hypo followed by clarification, filtration and then maintain enough residual for disinfection purposes.

2.1 Pilot Trial No 1

A Candy Tank (clarifier) was sourced from a decommissioned plant and placed on site and a 2 litre/second flow diverted through it. The process train was aeration, sodium hypochlorite dosing, flash mix, clarification and filtration.

Unfortunately the iron floc refused to settle even after trying various set ups which included the addition of polymer as well as lowering flow rates. Chlorine doses were also altered to attempt to maintain a residual after clarification, this also proved difficult.

2.2 Pilot Trial No 2 DAF

After being unsuccessful with conventional clarification we decided some outside expertise may be of assistance. Hunter Water were contacted and asked to conduct trials on the suitability of a DAF process. DAF jar tests were conducted on site to assess what was required to achieve successful clarification.

Various coagulants and flocculants were tested, these included:

- Alum
- Ferric Sulphate
- Poly ferric sulphate(PFS)
- Aluminium chlorohydrate (ACH)

- Flocculants - LT20, LT22 and LT22s
- All of these were used after dosing with chlorine.

The best performing were Ferric Sulphate, LT22 cationic polymer and ACH. Iron flocs using chlorination only were difficult to float without coagulation/flocculation treatment. We then decided to conduct a large scale pilot test using a DAF Plant which was hired from Water Treatment Australia. Water Treatment Australia conducted their own jar tests on the raw water and recommended the use of ACH (megapac23) as the principal coagulant. Aeration was still incorporated and caustic soda was also introduced to speed up iron and manganese oxidation prior to entering the DAF unit.

This trial went on for all of 2007 with the full plant flow being directed through the DAF unit.

During the nearly 12 months of trialling the DAF unit there were many problems encountered, following is a summary of the main ones.

- Taste issues – metallic taste after addition of hypochlorite early in the process stream. This led to many complaints from residents.
- Dirty Water events – Any slight problem with the DAF process led to iron passing through the filters. Iron + chlorine in the reticulation system!
- Use of increasing amounts of chemicals.
- Lack of a robust process chain - DAF was struggling with the quantity and type of floc produced.
- Manganese removal was not effective – approximately 30% removal only.

Figure 2 summarises the DAF /Filtration train performance over an extended period.

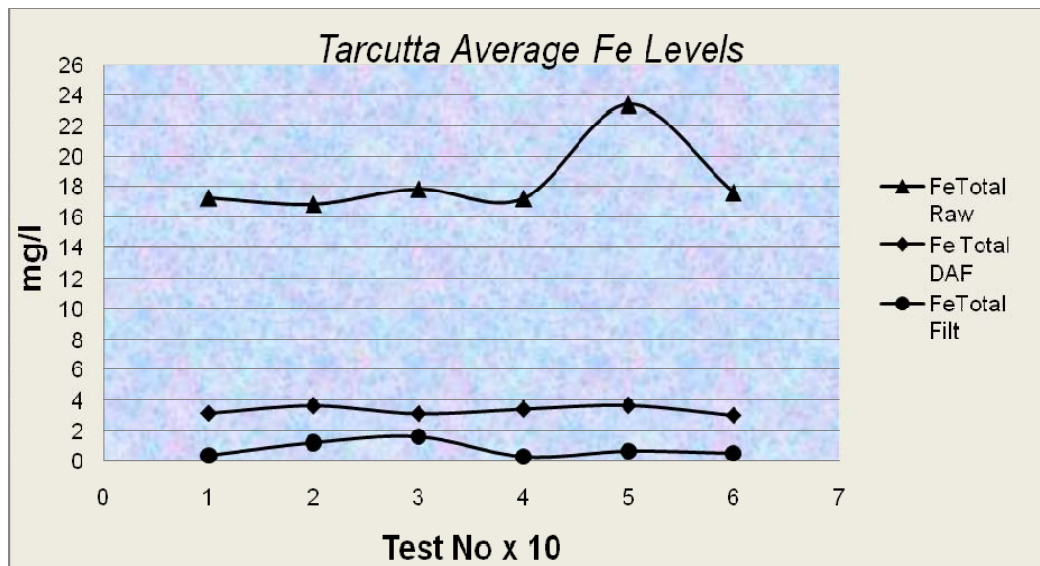


Figure 2: Tarcutta average Fe levels

Prior to Christmas 2007 the plant was reverted back to its original process train and chlorination was stopped. Residents had lost confidence and patience with what we were trying to achieve. Back to the drawing board.

2.3 Pilot Trial No 3 “Deferum” & DMI 65 Filtration

Early in 2008 our Senior Project Engineer received feedback about a process called “Deferum” which was capable of oxidising and filtering large amounts of iron from feed water.

A pilot filter was borrowed from Infinity Environmental and a flow of 0.6 litre/second directed through it. Positive results were obtained from the start.

The deferum process uses feed water supplied at around 65 psi to an aerator / degasifier. The feed water travels at up to 180km/hr and this creates a vacuum which speeds up gas removal and also allows atmospheric air to be sucked into the device causing the water to break up and form very high air/water contact surface. This combination accelerates gas removal and oxidation of iron.

The water then flows upward through a polymer floating filtering media (PFFM) and is decanted from the top of the filter.

Backwash is achieved using a hydro- automatic function. Simply put, as the filter becomes loaded with solids the water level builds up in the hydro- robot until a siphon is commenced and the filtered water at the top of the filter is used to backwash the media. There are no power requirements. Figure 3 shows a schematic of the filter.

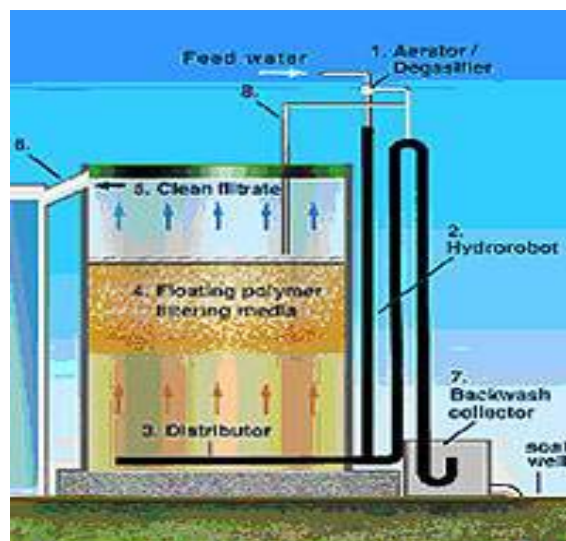


Figure 3: *Simplified schematic of the PWC Clean & Green free water filter*

To remove manganese after the deferum process a pool filter was purchased and filled with DMI 65 media from Quantum Filtration. DMI 65 is a catalytic filter media which is activated by soaking in an oxidant, in our case sodium hypochlorite. Once the media is ‘activated’ all that is required is a constant dose of hypochlorite while the filter is operational. This also achieves the required outcome of disinfection of the village supply.

Table 1 below provides an outline of the results from the pilot dual filtration system.

Table 1: *Summary of iron and manganese removal*

Raw Water		Deferum Filter		DMI 65 Filter	
Raw Fe	Raw Mn	Outlet Fe	Outlet Mn	Outlet Fe	Outlet Mn
18.4	0.67	0.08	0.67	0.01	0.03
18.4	0.67	0.04	0.74	0.07	0.04
18.4	0.67	0.08	0.62	0.04	0.03
17.6	0.66	0.07	0.48	0.00	0.02
19.4	0.65	0.06	0.6	0.05	0.02
16.6	0.67	0.07	0.63	0.00	0.02
19.1	0.67	0.16	0.37	0.06	0.02
22.5	0.68	0.12	0.42	0.02	0.03
11.9	0.7	0.01	0.7	0.00	0.03
18.2	0.65	0.09	0.66	0.0	0.01

Finally we had found a process that seemed to achieve the results we were after.

3.0 PROGRESS

Currently the new treatment plant is under construction. A deferum filter has been purchased from Pure Water Corporation based in Western Australia and installed on-site; the filter is capable of approximately 500 KI/day production. Stainless steel filters for the DMI65 media have been supplied by Water Treatment Australia.

The upgraded plant should be commissioned and brought on-line by the end of winter 2009 after which the old plant will be knocked down. Figure 4 below shows progress on the new plant as of February 2009.



Figure 4: *Progress on the upgrade of the Tarcutta WTP*

4.0 CONCLUSIONS

Riverina Water never envisioned the problems and the time and resources it would take to find a suitable process to remove iron and manganese at Tarcutta. Our persistence with the DAF plant trial contributed to the loss of confidence of our consumers which will take some time to repair.

- The dual filtration plant should achieve the following outcomes:
- Iron removal prior to addition of hypochlorite – less taste and odour issues.
- Minimal chemical use on site – hypochlorite only
- Manganese removal and disinfection in one process.

5.0 ACKNOWLEDGEMENTS

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