

Collingullie Water Treatment Plant Upgrade

Manganese Removal Using Hypochlorite

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Abstract

Collingullie is a small rural village located 20km's west of Wagga Wagga in southern NSW. The village has a population of approximately 200. Water is supplied from 2 bores situated near the Murrumbidgee River. Prior to the plant upgrade the only treatment was aeration and chlorination using gas.

Introduction

During 2003 the water quality being produced by the two bores started to deteriorate with levels of soluble manganese reaching 0.35 mg/l. The manganese entering the system was detaching from the pipes during peak flow periods and delivering "coke" to the consumers.

A Riverina Water County Council staff member who lives in the village was being contacted at all hours to flush mains. The problem intensified as the year progressed. Obviously we needed to act soon to restore customer's confidence and to maintain our staff member's sanity. A project engineer was assigned to investigate options for oxidation and removal of the manganese. It was decided to trial chlorine dioxide in place of the current chlorine gas.

A decision was made to trial chlorine dioxide as an oxidant and to install three second hand pressure filters, two steel and one Arkal plastic filter. These were available after decommissioning other small treatment plants in the area. A small Prominent chlorine dioxide dosing system was borrowed for the trial.

Body

Initial Set- Up

Initial "bucket testing" showed that the chlorine dioxide was successful in oxidising the manganese to its insoluble state. It was hoped that the filters would provide some greensand effect to adsorb any soluble manganese which was left and to catch the solids which were being produced.

The next step was to install all the associated equipment which was required to deal with filtration and solids handling on the plant. A second hand 7 L/second pump was found gathering cobwebs, so was installed as a filter pump. A new 8 l/sec backwash pump was purchased and also installed. Two plastic 25 Kl tanks were set up as Backwash and Clear water storage respectively. Backwash water initially was to be decanted after a 24hr settling period and allowed to run down an unused road easement, evaporation would do the rest.

Chlorine dioxide dosing of the incoming bore water was commenced late September 2004 and chlorine gas system turned off. The dosed water is then aerated and drops into a 30Kl holding tank which gives a theoretical contact time of 80 minutes. The water was then pumped through the 3 filters to the CWS and then to the village reservoir via the highlift pump.

A testing program was commenced to monitor Mn, pH, and free chlorine through the process and in the reticulation system. Results were encouraging and after around two weeks the levels of Mn coming through the filters started to decrease as the filters became 'seeded' with manganic manganese. Results of these tests can be seen in Table1.

Table1:

Date	Raw Water		Pre-Filter		Post- Filter		Finished Water		
	Mn- total mg/L	pH	Mn - total mg/L	pH	Mn- total mg/L	pH	Mn- total mg/L	pH	Free Cl (mg/L)
29/09/04	0.34	6.6	0.32	6.4	0.18	6.96	0.15	7.28	0.29
30/09/04	0.34				0.01				
1/10/04	0.34	6.75	0.32	6.5	0.01		0.03		0.16
5/10/04	0.31		0.31		0.03		0.03		0.14
12/10/04	0.350	6.69	0.344	6.57	0.036	7.3	0.027	7.45	0.24
19/10/04	0.33	6.75	0.33	6.63	0.007	7.15	0.001	7.38	0.19
20/10/04	0.33	6.63	0.34	6.56	0.01	7.22	0.01	7.33	0.23
21/10/04	0.33	6.78	0.33	6.64	0.01	7.29	0.01	7.25	0.17
22/10/04	0.33	6.73	0.33	6.59	0.01	7.24	0.01	7.22	0.19
25/10/04	0.33	6.43	0.32	6.34	0.01	6.99	0.01	7.23	0.1
28/10/04	0.355	6.72	0.35	6.71	0.018	7.33	0.008	7.28	0.21
29/10/04	0.328	7.01	0.322	7.00	0.038	7.41	0.019	7.43	0.29
3/11/04	0.315	6.91			0.039	7.34	0.013	7.48	0.12
8/11/04	0.34	6.93			0.068	7.45	0.017	7.48	0.12
10/11/04	0.322	6.79			0.004	7.28			0.07
16/11/04	0.316	6.91			0.004	7.29	0.003	7.2	0.07

The average total Mn leaving the plant during this period was 0.019mg/l.

The filters were being backwashed three times per week using around 5 Kl for the three filters. Dosing with chlorine dioxide continued until the 22nd of November with no major problems and no customer complaints. Chlorite levels were checked three times and were well within guidelines. Chlorine levels in the retic were monitored and kept around 0.15mg/l and 0.25 mg/l.

Chlorine Dioxide or Hypo?

After six weeks dosing with ClO₂ we decided to trial sodium hypochlorite to see if a less aggressive oxidant would do the same job.

I had been involved in a small treatment plant in South Gippsland which used hypo to oxidise Mn. The only issue with that plant was slightly elevated levels of THM's (still within guidelines). The Collingullie source water being bore water had low levels of organics and so we didn't think this would be an issue.

Dosing of hypochlorite commenced using a portable super chlorination unit with a commencing dose of 3mg/l which was soon dropped to 1.6mg/l. We noticed very quickly that total Mn levels in the finished water were still within our target of below 0.01mg/l.

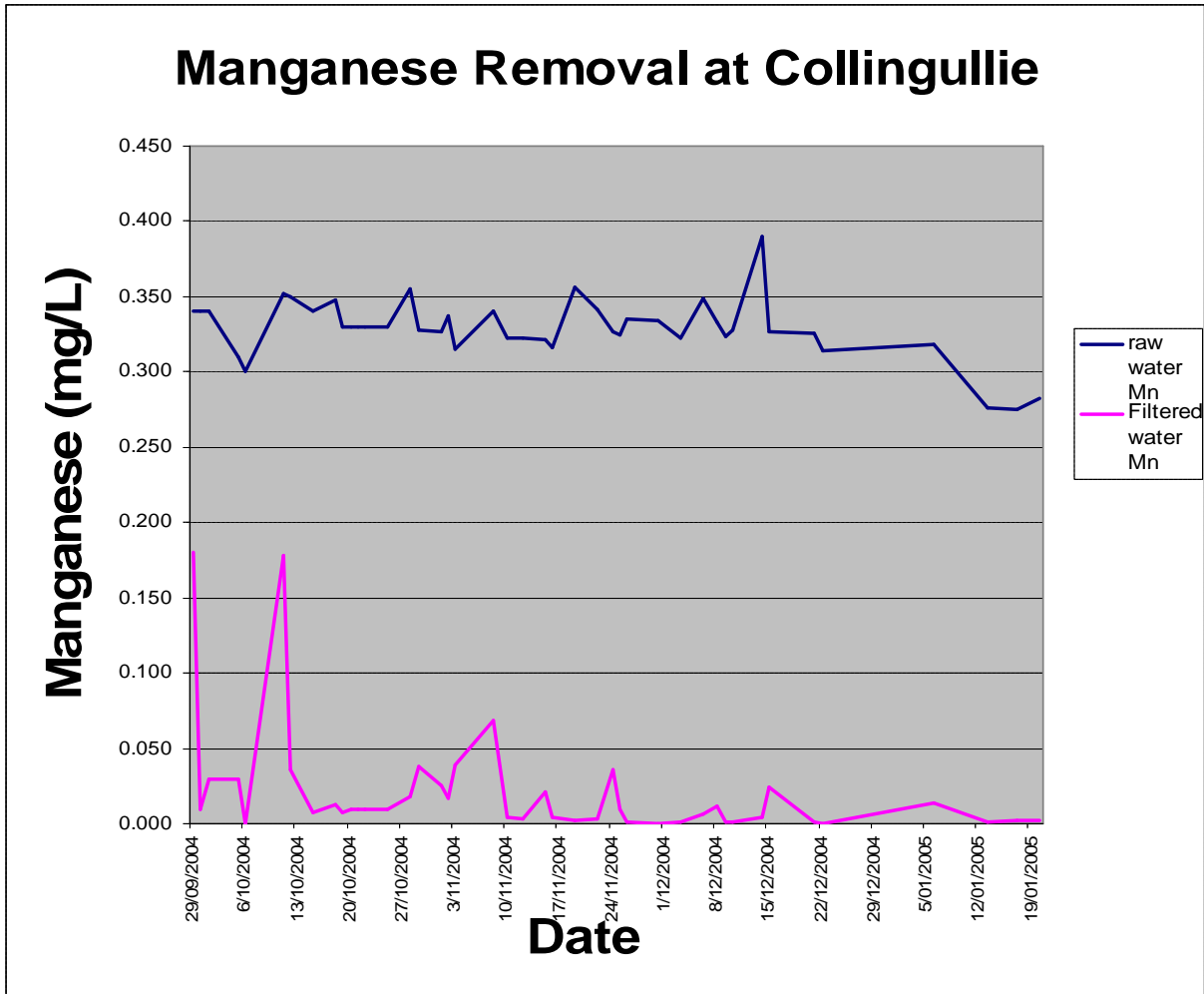
The advantages of using hypo over chlorine dioxide include:

- The obvious OH&S issues of handling and generation of a dangerous chemical, particularly at a small rural sight which is only visited three times per week.
- sodium hypochlorite's positive effect on pH.

Testing continued until the end of January 2005 with results better with hypo than with chlorine dioxide. This may be due to the "greensand" effect within the filters or from the slightly elevated pH values while using hypo. Results from testing while dosing with hypo can be seen in Table2.

Table2:

Date	Raw Water		Pre-Filter		Post- Filter		Finished Water		
	Mn- total mg/L	pH	Mn - total mg/L	pH	Mn- total mg/L	pH	Mn- total mg/L	pH	Retic. free Cl (mg/L)
25/11/04	0.325	6.54			0.01	7.21	0.02	7.13	1.58
26/11/04	0.335			7.12	0.001		0.001	7.28	1.63
3/12/04	0.322	6.6		7.13	0.001	7.29	0.001		1.45
6/12/04	0.349			7.3	0.006		0.009	7.18	0.9
8/12/04	0.333	6.55		7.11	0.012	7.16	0.014	7.29	0.89
9/12/04	0.324	6.65		7.01	0.001	7.6		7.59	0.89
10/12/04	0.328			7.26	0.001		0.001		0.74
14/12/04	0.39	6.5	0.283	7.07	0.004	7.2	0.001	7.36	0.77
15/12/04	0.327	6.54	0.266	7.4	0.024	7.39	0.001	7.6	0.8
21/12/04	0.326	6.5	0.258	7.1	0.001	7.32	0.001	7.41	0.87
22/12/04	0.314	6.61	0.251	7.23	0.005	7.43	0.001	7.35	1.19
6/01/05	0.318	6.65		7.02	0.014	7.06	0.008	7.05	1.42
13/01/05	0.276	6.75	0.213	7.45	0.001	7.49	0.001	7.37	1
17/01/05	0.275	6.6	0.261	6.9	0.002	7.16	0.018	7.18	1.24
20/01/05	0.282	6.79	0.282	7.1	0.002	7.6	0.002	7.67	1.58



Now that the treatment process was working well the attention turned to the reticulation system. The village mains were fully “pigged” and services air scoured in June 2005. The plant was then left to run as is until a full upgrade was commenced.

Plant Upgrade

After 12 months the plant upgrade was commenced. A core project team consisting of Riverina Water tradesmen and supervisors was assembled and would be under the control of the Project Engineer (the 3rd to work on Collingullie) The upgrade would include:

- Increasing both bores output to 10 l/sec. (one bore done in 2005)
- New Lowarra multistage vertical Highlift pumps.
- New backwash and filter pumps.
- Replacement of all pipe work.
- New Arkal filters to replace second hand steel filters.
- Concrete Clear water storage.
- Sewer connection for backwash water.
- New hypochlorite dosing system

- Installation of PLC and associated software to control plant.
- Rad-tel scada upgrade.

Work started with replacement of existing pipe work in July 2006 followed by installation of the new hypochlorite dosing system, Highlift, backwash and filter pumps and associated pipework. New Arkal filters were installed in March 2007. The new clearwater storage was delivered and installed in April 2007.

The auto control system is still being designed, installed and programmed as we speak and should be in finished by the end of this winter.

Conclusion

Removal of manganese using hypochlorite has proven to be a relatively “easy fix” at Collingullie. The manganese fully oxidises readily, possibly due to the low organics in the bore water and the pressure filters provide backup greensand effect.

The treatment plant upgrade has certainly taken some time from start to (hopefully soon) finish but because it was done in-house every one involved has learnt from the job and the staff pride in their workmanship has been evident

We have now moved on to the next “problem child” with- in the authority, the Tarcutta Treatment Plant. This plant is also bore water but with around 20 mg/l of soluble iron and 0.6mg/l of soluble manganese to be removed before chlorination. Any help greatly appreciated.

Acknowledgements

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