OPERATIONAL EXPERIENCE IN TREATING TEXTILE WASTES DISCHARGING INTO THE FARLEY WWTP

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61st Annual Water Industry Engineers and Operators' Conference
Civic Centre - Shepparton
2 and 3 September, 1998

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ABSTRACT

The Hunter Water Corporation provides water and sewerage services to approximately 420,000 people in the Newcastle area *(which is 2 hours drive north of Sydney)*. The Corporation operates twenty-one (21) wastewater treatment works (WWTW) which treat sewage from residential, commercial and industrial customers. These works range in size from small local plants treating sewage from a few hundred households to large automatic plants capable of processing sewage for over 200,00 people.

One of the Corporation's works is Farley WWTW which receives high pH waste from a large textile company in the sewer catchment. Over the past fifteen (15) years this discharge waste has caused a number of process problems which have been minimised through actions taken by the operational staff at the treatment works. This paper describes the problems that have occurred at the plant, the effects on the process and action taken to maintain good effluent quality.

KEY WORDS

Textile Wastes, Tradewastes, Wastewater Treatment

1.0 INTRODUCTION

The Hunter Water Corporation provides water and sewerage services to approximately 420,000 people in the Newcastle area *(which is 2 hours drive north of Sydney)*. The Corporation operates twenty-one (21) wastewater treatment works (WWTW) which treat sewage from residential, commercial and industrial customers. These works range in size from small local plants treating sewage from a few hundred households to large automatic plants capable of processing sewage for over 200,00 people.

One of the Corporation's works is Farley WWTW which receives high pH waste from a large textile company in the sewer catchment. Over the past fifteen (15) years this discharge waste has caused a number of process problems which have been minimised through actions taken by the operational staff at the treatment works. This paper describes the problems that have occurred at the plant, the effects on the process and action taken to maintain good effluent quality.

1.1 Farley Wastewater Treatment Works

Farley WWTW is located 4km south east of Maitland. The Farley Works services parts of Maitland, Telarah, Rutherford, Aberglassyn and Gilleston Heights as well as receives septic effluent and commercial wastes via road tankers from neighbouring areas. Approximately 60% of the loading on the Farley WWTW comes from a local textile factory in the sewer catchment which discharges high pH waste under a trade waste permit.

The Farley WWTW consisting of a Extended Aeration Activated Sludge Process *(Carousel)* was commissioned in 1983 with a design capacity of 50,000 EP *(equivalent persons)*.

The process units and schematic layout are described in detail in the attachments to this paper.
The current loading on the plant is 35,700 EP *(7.2 ML/day)* and produces a high quality effluent

(typically BOD, NFR and total Nitrogen less than 10mg/L) when not effected by high strength trade wastes. Also a large part of the treated effluent is being used for irrigation by local farmers and washdown activities at the treatment plant.

Chemical phosphorus removal with alum was implemented in 1997 in a Pollution Reduction Program (PRP) with the NSW EPA. The plant is monitored by a SCADA *(Supervisory Control and Data Acquisition)* System that represents graphically the plant and equipment items, and warns staff with alarms in case of process failures or disruptions.

The local textile factory has an agreement with Hunter Water to discharge waste which does not exceed a maximum flow of 4.3 ML/day and an instantaneous rate of 61L/S. If the pH exceeds a maximum of 12, a valve at the textiles factory automatically stops the trade waste discharge until pH is returned to a level below 12.

1.2 Textile Factory Discharge Waste

The local textile factory which employs approximately 400 staff, has a number of processes associated with the production of textiles. These processes include weaving of fabric, preparation of fabric *(scouring and bleaching)*, dying and finishing.

Some of the fabric is made on-site which involves sizing of the fabric *(which adds Poly Vinyl Alcohol (PVA) or starches to strengthen the fibres)*, weaving and subsequent washing. The majority of the fabric used on-site is now imported and has unknown preparation in terms of the chemical used in sizing. This imported material is washed which may release unknown chemicals into the wash water.

The next stage of treatment is preparation of the fabric for dying and involves scouring and bleaching of the cloth. This process utilises a large proportion of the caustic (80%) used on-site. The total daily consumption of caustic on-site is of the order of 4.5 tonnes. The bleaching process also utilises hydrogen peroxide. A caustic recovery unit collects the waste stream from the scouring process and concentrates it allowing it to be reused. The caustic from the bleaching process however does not go through the caustic recovery unit and this is the main source of caustic in the waste stream.

The fabric is then dyed using a number of different processes, both batch and continuous. The chemicals used in dying are salt, small quantities of caustic soda ash and dyes themselves. After dying the material is then finished using resins and starches. Table 1 quantifies the characteristics of the textile waste stream.

Table 1: ***Chemical Characteristics of Textile Wastes***

PARAMETER	MEAN	RANGE	STD. DEV.	NUMBER TESTS
PH	11.9	10.8 - 12.3	0.28	35
BOD (mg/L)	160	9 – 500	111	31
NFR (mg/L)	73	22 -3 08	52	33
Copper (mg/L)	0.61	0 - 1.79	0.5	33
Chromium (mg/L)	0.02	0 - 0.1	0.02	32
Temperature (C)	34	28 - 43	6.6	26
Conductivity	4 772	356 - 9 520	1 770	25

2.0 DISCUSSION

The waste stream from the textile factory has had a number of detrimental impacts on the treatment process at Farley WWTW. These have included :-

- High oxygen consumption
- Predominance of filamentous bacteria in the activated sludge process resulting in sludge bulking and a reduction in the available capacity of the sludge lagoons.
- The potential risk of a total kill of activated sludge biomass due to high pH *(as occurred in June 1990)*.

Table 2 lists the history of problems that have occurred at Farley WWTW due to the receivable of high pH waste from the textile factory.

Table 2: ***List Of Effects Of Waste From Textile Factory On Farley WWTP***

DATE	INCIDENT	EFFECT ON FARLEY WWTW	ACTION TAKEN BY OPERATIONAL STAFF
10 July 1990	*Accidental Discharge of 25,000 litres of 50% Caustic Soda discharged to Sewer*	Incoming effluent of pH 13.5 destroyed biological activity at Farley WWTW	♦ Increased aeration of plant. ♦ pH correction of biological reaction using acid. ♦ Tankering of seed. Activated Sludge from nearby WWTWs. ♦ Aeration of maturation pond to treat effluent while process was being established. ♦ Shutting down discharge line from textile factory while process was being re-established. ♦ Increased pH monitoring.
1 November 1990	*Large Volumes of High pH wastes from textile factory*	♦ pH alarm in Biological reactor recorded 9.5. ♦ Poor settling in clarifiers and floc carryover to maturation ponds. ♦ Reduced biological activity in reactor.	Plant Operation changed to bypass high pH incoming wastes through sludge lagoons to reduce pH.
29 August 1991	*Operational Problems with Caustic Recovery Unit*	High pH alarm in Biological Reactor	Plant Operation changed to bypass incoming wastes through sludge lagoons.
16 March 1993	*Faulty pH probe at textiles factory resulted in textile factory correcting wastes with acid.*	No effect	Assisted textile factory staff in calibrating pH meter.
30 July 1993	*High pH wastes from textile factory >12*	♦ High aeration required at PlantW. ♦ Poor settling sludge. ♦ Carry over of bulking sludge to Maturation Ponds.	Increased aeration in Biological Reactor.

DATE	INCIDENT	EFFECT ON FARLEY WWTW	ACTION TAKEN BY OPERATIONAL STAFF
26 November 1994	*Suspected High pH wastes from textile factory >12.*	Inflow pH monitor at Farley WWTW was reading high	Re-calibration of pH probe at Farley WWTW.
11 April 1996	*Textile factory carry out trial using CO_2 Gas to reduce pH in waste stream.*	Carryover of sludge from clarifiers due to excess CO_2 release.	CO_2 gas trial was discontinued.
16 May 1996 22 May 1996	*High pH 12.8 in waste stream*	♦ Foaming in clarities and settleability problems. ♦ Carryover of sludge into maturation ponds. ♦ pH of 9.3 in effluent from clarifiers.	Plant Operation changed to bypass incoming flow through sludge lagoons
16 October 1996 25 November 1996	*Large volumes of High strength wastes*	♦ Sludge build up in clarifiers ♦ High pH in Biological reactor	♦ Plant operation changed to bypass. ♦ Textiles factory taken off-line.
13 January 1997 17 January 1997	*High pH and flow after Christmas shutdown for 2.5 weeks*	♦ Sludge build up in clarifier ♦ High pH in Biological reactor.	Textile factory acid dosed to reduce the effects on Farley WWTW.
7 April 1998 10 April 1998	*High pH and flow after Easter shutdown*	♦ Sludge build up in clarifier ♦ High pH in Biological reactor.	Textile factory acid dosed to reduce the effects on Farley WWTW.
22 May 1997	*High pH and flow due to caustic recovery system*	♦ Sludge build up in clarifier ♦ High pH in Biological reactor.	Textile factory acid dosed to reduce the effects on Farley WWTW.
22 January 1998	*New CO_2 gas trial*	Problems repeated as previously in April 1996	CO_2 Gas trial discontinued.
May 1998	*Waste stream normal pH <11.8*	Acid dosing trial at Farley WWTW to control high pH wastes in Biological reactor as well as assist chemical P removal by reducing alkalinity in effluent.	By decreasing pH in biological reactor down to 7.5. Activated Sludge Process performed excellently, however Chemical P removal did not improve consistently.

3.0 CONCLUSION

Over the fifteen (15) years that the textile factory has been operating and discharging high pH wastes *(ie. >11.0)* to Farley WWTW, consistent problems have occurred with :-

- High Oxygen Consumption
- Sludge Bulking
- Carryover of sludge into Maturation Ponds
- Decreasing capacity of Sludge Lagoons
- Potential Risk of Biomass Kill.

Operational staff action to combat these problems have involved :-

- Increasing aeration
- Increasing sludge wasting
- Bypassing raw sewage via sludge lagoons
- Installing pH probes in Biological reactor as early warning
- Installing pH probe in waste stream at textile factory with action to shut off discharge valve when pH is >12.0.
- Carrying out acid dosing trial at Farley WWTW *(using sulphuric acid to dosed biological reactor)*.

However, despite all these actions carried out by operational staff which have assisted enormously in reducing the frequency of the final effluent being outside the EPA licence requirements, the potential of a major problem still exists.

The final solution to the above problem rests with the source namely the textile factory who needs to carry out a waste minimisation audit and install a pre-treatment process that will reduce the pH in the tradewaste discharge to < 11.0. As well as construct an on-site storage dam *(to hold one day's storage)* in order to balance out peak flows and tradewaste effluent quality discharged to Farley WWTW.

Figure 1 – ***Farley WWTP Process Flow Sheet***

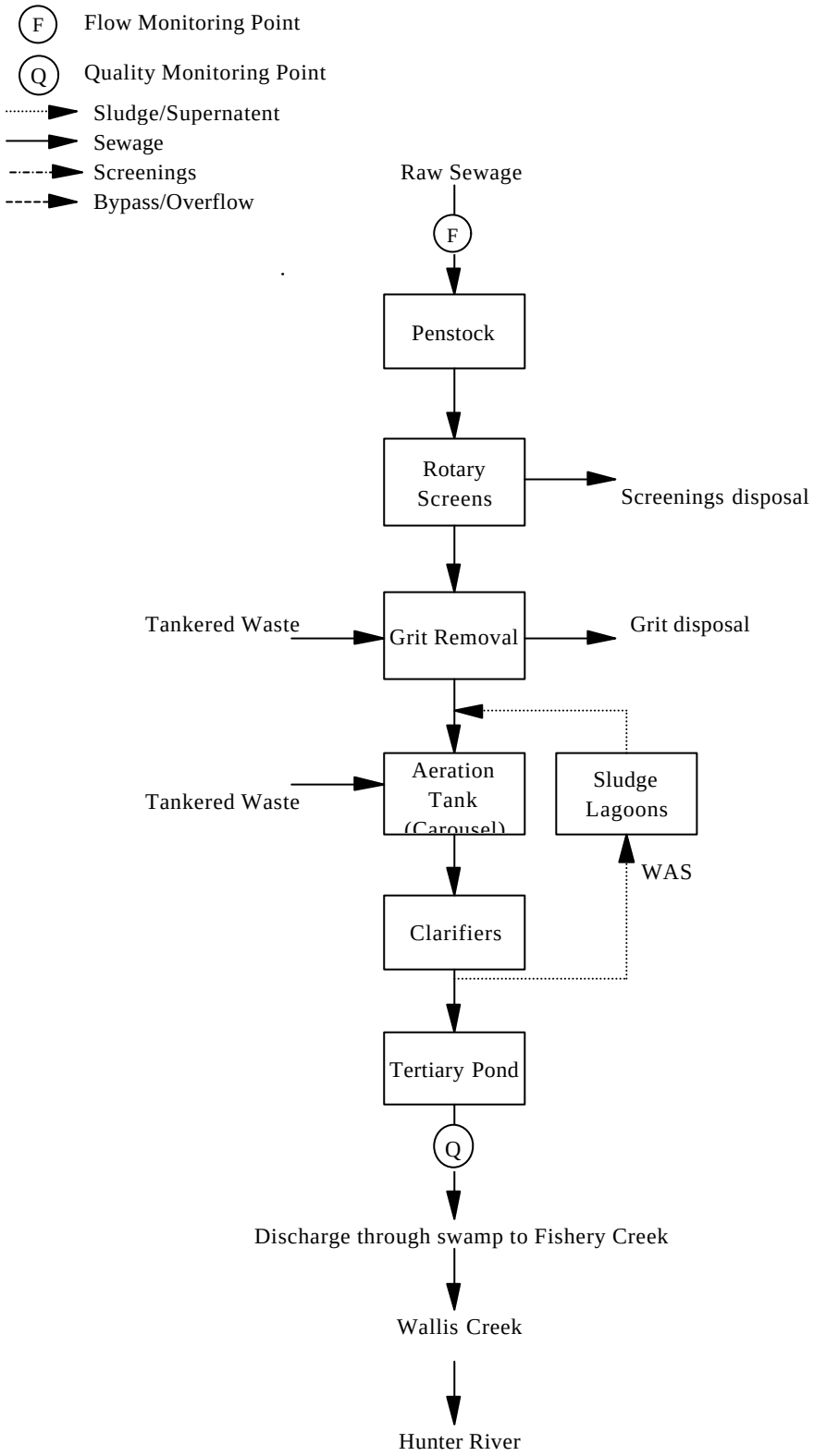

Figure 2 ***Fact Sheet – Farley Wastewater Treatment Plant***

Process - Carousel Extended Aeration Activated Sludge

Design Capacity

EP	-	50,000
ADWF	-	14.6 ML/d
PDWF	-	26.3 ML/d
PWWF	-	97.1 ML/d

Inlet Works

(a) Screens

Number	-	2
Type	-	"Contra-Shear" Rotary
Aperture	-	2 mm
Capacity	-	600 l/s
Screening Press	-	Hawker Siddeley-Temact Model 300B

(b) Grit

Number	-	1
Type	-	PISTA
Capacity	-	880 l/s

Aeration Tank (Carousel)

(a) Physical Characteristics

Number	-	1
Length	-	103.3 m
Width	-	9 m
Depth	-	3.75 m
Volume	-	20,500 m^3

WAS Pump

Number	-	1
Capacity	-	40 l/s

(b) Aeration Characteristics

Number of Aerators	-	3
Type	-	Envirotech vertical shaft surface aerators
Impeller Diameter	-	2,146 mm
Speed	-	33 rpm
Motor	-	93 kW

Secondary Clarifiers

Number	-	2
Diameter	-	26 m
Side wall depth	-	3 m
Surface Area	-	530.9 m^2

RAS Pumps

Number	-	2
Type	-	Submersible
Power	-	8.8 kW
Capacity	-	130 l/s

Sludge Lagoons

Number	-	2

Volume(each)	-	14,806 m^3

Tertiary Ponds

Number	-	2
Depth	-	2 m
Volume (total)	-	172,500 m^3

Chemical Phosphorus Removal

Storage Tanks

Number	-	2
Diameter	-	3 m
Height	-	4.2 m
Volume(each)	-	25 kL (2 weeks storage)

Dosing Pumps

Number	-	2
Power	-	0.37 kW
Capacity	-	6 l/min

Sump Pump

Number	-	1
Power	-	0.48 kW
Capacity	-	11.2 m^3/hr

Flowmeter

Range	-	20-250 L/hr

Dosing at incoming waste stream, mixed liquor and clarifier feed.

Flow Measurement

(a) Inlet Flow

Number	-	1
Type	-	Danfoss electromagnetic flowmeter
Capacity	-	600 L/s

(b) Clarifier Outlet

Type	-	Venturi flume
Flow range	-	0- 250 L/s

(c) Pond Outlet

Type	-	"V" notch weir
Flow range	-	0- 600 L/s

Effluent Discharge

(a) Fishery Creek

(b) Effluent re-use (irrigation)