MANTECH Publications

Journal of Transportation Engineering and Its Applications

Volume 2, Issue 2, May-August, 2017

An Effluent Treatment Plant in Automotive Axles Limited, Mysuru- A Case Study

Shivaprasad H[1], Chiranthana N[2],Gowtham Prasad M E[3], Shailaja M[4], Kiran S P[5], Chethan R[6], Kiran Kumar C M[7]

Assistant Professor[1, 3], Associate Professor[2], Students[4, 5, 6, 7]

Department of Civil Engineering

DBIT, Bangalore, Karnataka state[1, 3, 4, 5, 6, 7]

CIT, Karnataka state, India[2]

Corresponding Author's email: *shivaprasad.h61@gmail.com[1]*

Abstract

Automotive Axles Limited (AAL) was established in 1981, AAL is joining venture of kalyani group and Arvin Meritor Inc, USA. With manufacturing facilities located at Mysuru, the company is currently the largest independent manufacture of rear drive axle assemblies in country, over the year, automotive axle limited has developed an impressive domestic clientele that includes Ashok Leyland, Telco, Vehicle Factory, Jabalpur, Mahindra and Mahindra, Volvo and Bharat Earth Movers. The infrastructure at AAL spans highly specialized manufacturing process involves friction welding, CO2 welding, CNC machine, Flexible machine centre and a range of specially build machine for production of axle and brakes. The facilities also comprised Gleason gear manufacturing equipment backed by a modern heat treatment shop including continuous carbonizing and sealed quench furnaces. Range of rear drive axle catering to commercial vehicle ranging from 6 Tons to 35 Tons GCW, Scam actuated quick change air breaks for commercial vehicle and trailer axles for 10 Tons to 13 Tons GVW.

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The project works comprises of study of various unit of existing effluent treatment plant (ETP) at AAL Mysuru, along with characteristic of raw and treat effluent. The ETP is designed to treat industrial effluent. The ETP consist of an equalization tank, neutralization tank, aeration tank, settling tank, filter media, sludge drying beds etc.

Automotive axle limited now proposed to set up 200 KLD capacity effluent treatment plant, with the state or art technology. The proposed manufacturing process is basically the same as existing process. Environmentally significance operation will be identified at suitable mitigation measures will be adopted to safeguard adverse impact on the environment.

Keywords: *Automotive Axles Limited (AAL), Effluent Treatment Plant(ETP)*

INTRODUCTION

1.1 A Brief History of AAL

Automotive axles limited (AAL) is a public limited company established in 1981 under the company act,1956, jointly promoted by Bharat Forge Limited, Poona and Arvin Meritor, Inc, USA (formerly known as Rockwell International Corporation), with its Registered Office and Works situated at Hootgalli Industrial Area, Off Hunsur Road, Mysuru 570018. AAL is engaged in manufacture rear drive axle, tandem axles, trailer axles, housing, Gear and sets and brake components including therefore with strong technical and state-of-art technology support from Arvin Meritor, USA.

The company measured domestic customer are Ashok Leyland limited, Tata motors, Mahindra and Mahindra, Volvo India limited, Force motor limited, Asia motor work, Eicher motor limited, and Sawarajmazda limited. The major domestic customers are Ashok Leyland Limited, Tata Motors, Mahindra & Mahindra Volvo India Ltd, Force Motors Limited, Asia Motor Works, Motors Ltd and Swarajmazda Limited. The major overseas customers are Arvin Meritor plants in the US, Italy, Turkey, France, Brazil, China and Australia. Effective first April 1999, marketing of our products (domestic and export are made

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throughout Meritor HVS (India) limited, Mysore.

AAL was awarded ISO/TS-16949:2002 certification during July 2005, and environmental management system EMS–ISO 14001:2004 certification during July 2006.

1.2 Land

The existing plant of AAL is located in an area of 20.23 hectors (50.00 acres) of land, which was acquired from KIADB. The breakup of land used is given below in table 1.1:

Table 1.1: Plant location and details

LAND USE	Sq.Mtrs
Total land area	202335
Built-up area	39860
Greenbelt	86036
open space	76440

1.3 Salient Feature of Plant Site

The silent features of the plant site is given below in the table 1.2

The table 1.2: silent feature of the plant site.

Table 1.2

FEATURES	DETAILS
Maximum Temperature	38ºC
Minimum Temperature	15.9 ºC
Average Rainfall	800 mm

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Topography	Plain land, gently sloping towards NE
Nearest water Body(River)	Kaveri River
Nearest Highway	Mysuru Mangalore Highway
Nearest Railway Station	Mysuru Railway station- 8 km
Nearest Village	Hootagalli: 1 km Kooragalli: 0.2 km
Nearest City	Mysore-10 km
Nearest Airport	Mysore-20 km

1.5 Objective of the Present Study:

1) Safeguards in the project feasibility and design phases.

2) An effort made to arrive at the mass balance of water used and the wastewater released in the industry considering the raw materials and the production process.

3) Qualification of the waste water based on the detail provide by the industry personal, the characteristic of waste water from similar industry has been considered in the designing the sequence of treatment.

4) Physical, chemical and biological treatment system has been designed to arrive at the permissible limit pursuit by the state control board for suitable end use.

5) To obtain inform assessment of potential environmental issues to support consults report in discussion with interested government agencies, non government organization and the community.

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Table 2.1 Characteristics of Wastewater from Selected In India

SL NO	Name of The Industry	Amount w/w produced per unit of production	Unit of production	pH Value	SS Mg/l	Typical BOD_5 Mg/l	Typical COD Mg/l	Typical BOD_5/COD Ratio	BOD Load Kg of product	Characteristics
1	Dairy	$7m^3$	M^3	7.2-8.0	700	800	1340	0.66	5.7	Oil and Grease putrescibility
2	Distillery	$14m^3$	M^3	3.9-4.3	4500-12000	40,000	80,000	0.5	560	High TDS,CL,SO_4
3	Fertilizer	$9m^3$	Tonnes	7.5-9.5	3700	30	-	0.09	-	High NH_3 and Urea NO_2 High arsenic and oil
4	Oil Refinery	$1.7m^3$	Tonnes	-	200-400	200	-	-	0.34	High qty of free and emulsified oil H_2S
										H_2S
5	Paper and Pulp	$300m^3$	Tonnes of paper	6.5-8.2	1000-3000	160	610	0.26	50	Lignin, colour
6	Sugar Mills	$3m^3$	Tonnes	4.6-7.1	220-800	300-2000	600-4400	0.7-0.5	-	Low pH, High Alkaline
7	Textiles	$25m^3$	Tonnes of crushed	7.0-10.0	375	375	525	0.166	8.75	Zn,Polysulphides

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2.4 Treatment of Wastewater in AAL

The main sources of wastewater at this AAL are the lapping waste, floor wash effluents, coolant wastewater, phosphatising effluent, paint booth effluent. Wastewater from these units is separately collected and transported through drains and later gets combined at a junction points and from there it reaches the effluent treatment plant situated at the backside of the workshop units.

In AAL, various physical, chemical and biological treatments are conducted on the wastewater, to get an effluent of proper standards.

The various units in ETP are

1) Equalization Tank
2) Neutralization Tank
3) Aeration Tank
4) Settling Tank
5) Sand Filter
6) Sludge Drying Bed

DESCRIPITION OF EXISTING ETP

1.1 Preface

The Effluent treatment plant situated in the premises of AAL, Mysuru consist of the following units.

- Fine screen chamber
- Collection tank
- Reaction tank
- Parallel plate separator
- Ultra Filter
- Clariflocculator
- Pre Filtration tank
- Pressure Sand Filter
- Activated Carbon Filter
- Aeration tank
- Settling tank

The treated plant is designed to treat the effluent of following characteristics Flow 50m3/day (Considering 12 hours pumping) The inlet parameter of the influent reaching ETP are as follows and given below in Table 5.1. The values are average taken for a 12 hours pumping

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Table 5.1: Inlet parameters

Sl no	Parameters	Values
1	pH	6.5-8.5
2	BOD	250-300
3	COD	500-800
4	TSS	400-500

The outlet parameters required, as per ISI standards are given in Table 5.2 below:

Table 5.2: Outlet parameters

Sl no	Parameters	Values
1	pH	6.5-7.5
2	BOD	<30 mg/l
3	COD	<250 mg/l
4	TSS	<50 mg/l

1.2 Description of Existing ETP

The following points describe the various steps by the ETP works

1. The Paint Booth Effluent / phosphating effluent, floor wash / lapping and coolant effluent.

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2. The collection effluent is overflowing to parallel plate separator; from there it is taken to clariflocculator.

3. The neutralized effluent is overflowing to parallel plate separator, from there it isTaken to clariflocculator

4. The sludge which is obtained is passed to a filter press where in filtrate is passed to the pre-filtration.

5. The treated effluent is then passed to pressure sand filter and then to activated carbon filter.

6. The treated effluent is later aerated in the aeration tank and settled in setting tank.

7. For future dilution and reuse it is passed to the STP.

System Capabilities

- Removes suspended and colloidal solids
- Removes complex organics
- Reduces COD
- Maintains neutral pH
- Removes odor from effluent

1.3 Design of Effluent Treatment Plant:

1. Design Data

Effluent characteristics:-

Flow	:	48KLD
pH	:	6.88
COD	:	1800 mg/ltr
Suspended Solids	:	112 mg/ltr
Oil & Grease	:	40-50 mg/ltr

2. Collection Tank:

A) Collection Tank – for paint booth effluent

To equalized the flow parameters and to remove retention period of 4 hrs of flow.(Before the effluent enter in to the parallel plate separator)

Pumping hours = 12

Flow rate = 50KLD/12= 4.17 KL/Hr

Volume of Collection tank required = 4x4.17=16.66KL

Provide motorized Oil and Grease Trap

B) Collection Tank- II for Floor wash/lapping

To equalize the flow parameter and to provide Retention period of 4 hrs of flow.(Before the effluent enters in to the parallel plate separator)

Pumping hours = 12

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Flow rate – 100KLD/12=8.33KL/Hr

Volume of Collection Tank require = 4x8.33=33.33KL

Provide Motorized Oil and Grease Trap.

C) Collection Tank- III for Coolant effluent

To equalized the flow parameters and to provided retention period of 4 hrs of flow.(Before the effluent enter in to the Parallel plate separator)

Pumping hour = 12

Flow Rate = 50KLD/12=4.17KL/Hr

Volume of Collection Tank required = 4x4.17=16.66KL

Provide Motorized Oil and Grease Trap.

D) Reaction Tank

De- emulsification of Oil and Grease by Alum addition and to maintain pH of 0.8

Pumping hour = 12

Flow Rate = 50KLD/12=1.7 KL/Hr

Volume of Reaction Tank required = 4x4.17=16.67 KL

3. Parallel Plate Separator

Detention time 2 hours

To prepare the effluent with lime addition in the flash mixing tank for precipitating metal sludge.(Flash mixing size of 1m x 1m)

Flow rate = 48KLD/12= 4 KL/Hr

Volume of Tank required= 2 x 4 = 8 KL

4. Clariflocculator Tank:

Considering sludge recycling to aeration tank from settling tank @ 100% is 48 x 2=96KLD

Consider surface loading @25 m3/m2/day

Area of settling Tank = 96/25 = 4m2

Provided polyelectrolyte dosing

5. Pre-Filtration Tank:

Detention time of 4 hours

Pumping hours = 12

Flow Rate = 48 KLD/12= 4KL/Hr

Volume of Pre- filtration Tank required =4 x 4 = 16KL

6. Dewatering of Sludge:

The settled sludge is disposal as manure by dewatering the sludge using Filter press.

Size = 24” x 24” – 1 No

7. Pumps:

Capacity of 12.5 m^3/hr @ 10m head – 8 Nos

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8. Pressure Sand Filter

Flow = 48KLD

Considering working hours = 12 hrs

Flow = 4m3/hr

To provide Filter size : 1.5mø – 1 No With sand and gravel media

9. Activated Carbon Filter

Flow = 48 KLD

Considering working hours = 12 hrs

Flow = 4m3/hr

To provide Filter size : 1.5mø – 1 No With carbon media

10. Aeration and settling Tank

Providing one day of duration for 48KL

The existing STP facility shall be used for this purpose.

1.4 Treated Effluent Characteristics

The treated characteristics are frequently analyzed on a regular basis, to keep a tab on the effluent quality. The various parameters under scrutiny are the physical and chemical characters like pH, COD, Oil and Grease, free ammonia and total nitrogen, conductivity. These analysis report shown that treated effluent characteristics are very much conforming to the IS and PCB standards.

The table following table shows the various treated characteristics of two recently analyses, with the limit and units.

Table 5.3 Treated Effluent Analysis Report

Sl no:	Parameters	Units	IS Standard	Result (March 2017)	Result (April 2017)
1	pH	pH	5.5-9.0	7.7	6.4
2	TDS	Mg/l	2100	876	1120
3	TSS	Mg/l	100	24	32

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4	Chlorides	Mg/l	1000	520	612
5	Residual free chloride	Mg/l	1	-	-
6	Sulphate	Mg/l	1000	115	124
7	BOD	Mg/l	30	3.0	28
8	COD	Mg/l	250	43	146
9	Oil and Grease	Mg/l	10	4.8	6
10	Free Ammonia	Mg/l	5	4	4
11	Total Nitrogen	Mg/l	100	39	56
12	Conductivity	µs/cm	2250	1390	1420

6.5 Desing Calculation Of Proposed Effluent Treatment Plant:

1. Design Data:

Combined Effluent characteristics:-

Flow : 200KLD

pH : 6.88

COD : 2000mg/ltr

Suspended Solids : 112mg/ltr

Oil & Grease : 40-50mg/ltr

2 Collection Tank:

A) Collection Tank –I for booth effluent

To equalize the flow parameters and to provide Retention period of 4 hrs of flow

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(Before the effluent enters in to the parallel plate separator)

Pumping hours=12

Flow Rate= 50 KLD/12=4.17 KL/Hr

Volume of Collection Tank Required=4*4.17=16.67 KL

Provide motorized oil and grease trap/skimming tank

Oil and grease trap is provided for the removal of oil only from the process waste water,

Design Includes

Flow= 50 KLD

Assume detention time= 4 mins

Assume compressed air of= $0.3m^3$ for 50KLD

Vr= 0.25m/min

The area required for the tank is calculated by using the formula,

A= 0.00622*(Q/Vr)

=0.00622*(50/0.25)

$A=1.24m^2$

Assuming the width as 0.5m, the Length of the tank is=Surface area/width

=1.24/0.5

=2.5m

Thus, Actual Surface area= 2.5*1.5

$=3.75m^2$

Volume of the Tank=Flow*Detention Time=50*4 $=0.138m^3$

Hence, minimum depth of the tank= 0.138/1.24= 0.11m

Provide a minimum depth of 0.5m and a free board of 0.2m

Hence provide oil and grease trap of dimension (2.5*0.5*0.5) m

B) Collection Tank –II for Floor wash/lapping

To equalize the flow parameters and to provide Retention period of 4 hrs of flow. (Before the effluent in to the Parallel plate separator)

Pumping hours= 12

Flow rate= 100KLD/12= 8.33 KL/Hr

Volume of collection Tank required= 4*8.33= 3.33 KL

Oil and grease trap is provided for the removal of oil only from the process waste water,

Design includes

Flow= 100KLD

Assume detention time= 4 min’s

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Assume compressed air of= 0.5m³ for 50KLD
Vr=).25m/min

The area for the tank is calculated by using the formula,

A= 0.00622*Q/Vr= 0.00622*100/0.25
A= 2.48m²

Assuming the width as 1.0m, the length of the tank is= surface area/ width
= 2.48/1.0
= 2.48m

Thus, Actual surface area= 2.48*1.0= 2.5m²
Volume of the tank= Flow*Detention time= 100*4= 0.277m³

Hence, minimum depth of the tank= 0.277/2.48= 0.11m
Provide a minimum depth of 0.5m and a free board of 0.2m Hence provide oil and grease trap of dimension (2.5*1.0*0.5) m

C) Collection Tank **–** III for coolant effluent

To equalize the flow parameters and to provide retention period of 4 Hrs of flow.(Before the effluent enters in to the Parallel plate separator)

Pumping hours= 12
Flow rate= 50KLD/12= 4.17 KL/Hr

Volume of Collection tank required= 4*4.17= 16.67 KL
Oil and grease trap is provided for the removal of oil only from the process waste water.

Design includes
Flow= 50 KLD
Assume detention time= 4 min's
Assume compressed air of= 0.5m³ for 50KLD
Vr= 0,25m/min

The area required for the tank is calculated by using the formula,

A=0.00622*Q/Vr = 0.00622*50/0.25 A= 1.24m²

Assuming the width as 0.5m, the length of the tank is= Surface area/ width
=1.24/0.5
= 2.5m

Thus, Actual surface area= 2.5*1.5= 3.75m²

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Volume of the tank= Flow*Detention time= 50*4 = 0.138m³

Hence, minimum depth of the tank= 0.138/1.24= 0.11m

Provide a minimum depth of 0.5m and a free board 0f 0.2m.Hence provide oil and grease trap of dimension (2.5*0.5*0.5)m

D) Reaction Tank

De-emulsification of oil and grease by Alum addition and to maintain pH of 0.8

Pumping hours= 12

Flow rate= 50 KLD/12= 4.17 KL/Hr

Volume of Reaction Tank required= 4*4.17 Kl/Hr

Volume of reaction tank required= 4*4.17= 16.67 KL

1. Parallel Plate Separator

Detention time 2 hours.To prepare the effluent with lime addition in the flash mixing tank for precipitating metal sludge.

(Flash mixing size of 1m * 1m)

Pumping hours= 12

Flow rate= 200KLD/12= 16.67 KL/Hr

Volume of Tank required= 2*16.67= 33.34 KL

2. Clariflocculator Tank

Consider sludge recycling to Aeration tank from settling tank @ 100%

200*2= 400 KLD

Consider surface loading @ 25m³/m²/day

Area of settling tank= 400/25= 16m²

Provide polyelectrolyte dosing.

3. Pre-Filtration Tank:

Detention time of 4 hours

Pumping hours= 12

Flow rate= 200 KLD/12= 16.67 KL/Hr

Volume of Pre filtration tank required= 4*16.67= 66.68 KL

4. Dewatering of Sludge:

The settled Sludge is disposed as manure by dewatering the sludge using Filter press.

Size= 24"*24" - 1 No.

5. Pumps:

Capacity of 12.5m³/hr @ 10m head – 8 Nos

6. Activated Carbon Filter

Flow = 200 KLD.

Consider working hours = 12 hrs.

Flow = 16.67m³/hr.

To provide Filter size : 1.5m ø – 1 No. With sand and gravel media

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7. Activated Carbon Filter

Flow = 200 KLD.

Consider working hours = 12 hrs.

Flow = 16.67m³/hr.

To provide Filter size : 1.5m ø – 1 No. With carbon media

8. Aeration and settling Tank

Providing one day of duration for 200 KL The existing STP facility shall be made use for this purpose.

6.6 Regulatory Compliance- Legislative requirements

The company is complying with relevant Environment Protection Acts & Rules including Water [prevention & control of pollution] Act 1974 7 Air [prevention & control of pollution] Act 1981 and rules.

It valid consents under Water Act, Air Act, & Authorization under Hazardous Waste Management Rules 1989. Monthly returns as per consent condition are filed regularly

CONCLUSIONS

The following conclusions could be drawn from the overall study:

1. It is proposed to have a compact state - the – Art Technology 200KLD capacity effluent treatment plant including Advance Tertiary is provide so as to reuse, as well as meeting PCB standards suitable for safe discharge on own land conserve the water within premises.

2. The treated industrial wastewater is effectively used for gardening

3. Also all activities will be carried out ensuring minimal environmental pollution and with all necessary controls in place.

4. To establish adequate baseline data against which future performance and change can be measured.

REFERENCES

1) Hammer, Mark J. (1975). Water and Waste-Water Technology. New York: John Wiley & Sons.

2) Kemmer, Frank N. (1979). The Nalco Water Handbook. New York: McGraw-Hill Book Company.

3) Metcalf; Eddy (1972). Wastewater Engineering. New York: McGraw-Hill Book Company.

4) Patterson, James W. (1980). Wastewater Treatment Technology.

Page 43-58 © MANTECH PUBLICATIONS 2017. All Rights Reserved

Ann Arbor, Michigan: Ann Arbor Science.

5) S.K Garg (1999), Environmental Engineering (Vol II), Khanna Publications.

6) Rao and Dutta (1987), Wastewater Treatment, II Edition, oxford and IBH Publishing company Pvt Ltd, India.

7) Enviromental Statement Report by AAL.

8) Bhole. A.G (1990) "Manual of wastewater Treatment Plant Design", AICTE Manual, India.

9) Eckenfleder (2000), "Industrial Water Pollution Control", II Edition, McGraw Hill Series, Inc., India.

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