Study on the Cationic and Anionic Pollutants of Waste Water Released from Rubber Factories of Mawlamyine Industrial Zone

Aye Aye Cho[1], Aung Aung[2], Myat Myat Thaw[3]

Abstract

The aim of the research work is to study the cationic and anionic pollutants of waste water released from rubber factories. Waste water samples were collected from Ever Flow River (EFR) Rubber Factory and Ko Win Ngae (KWN) , Ma Ni Ni Thein Rubber Factory (No.122, 3rd street, Shwemyotaw) in Mawlamyine industrial zone. These waste water samples were made by chemical waste water treatment methods used for the removal of cationic and anionic pollutants. Both conventional and instrumental methods were used for the determination of pH, EC, TDS, acidity, alkalinity, hardness (total, permanent, temporary) , Cl^-, PO_4^{3-}, SO_4^{2-}, SiO_2 ,Na^+ , K^+, Ca^{2+}, Mg^{2+}, Fe^{2+} , Pb^{2+}, Cd^{2+} and chemical oxygen demand of waste water samples of before and after chemical treatment. Effective chemical waste water treatment methods are surveyed and discussed to find a way of removing cationic and anionic pollutants from the waste water released from rubber factories.

Keywords*: *Cationic and anionic pollutants, waste water, rubber factories, Mawlamyine industrial zone.

Introduction

Industries are major sources of pollution in all environments. Based on the type of industry, various levels of pollutants can be discharged into the type of industry, various levels of pollutants can be discharged into the environment directly or indirectly through public sewer lines. Waste water from industries includes employees' sanitary waste, process wastes from manufacturing, wash waters and relatively uncontaminated water from heating and cooling operations (Emongor *et al*., 2005).

Waste water is an unavoidable by-product of rubber processing: whatever processing procedures are used for preparing products from latex, there will always be an aqueous liquid as a by – product (Ademoroti, 1982). About 60 percent of the latex exuded by a rubber tree is water. Like any other natural plant product, it contains a variety of substances as well as the commercially important constituent, in this case rubber hydrocarbon. Also present are proteins, minerals, non-rubber hydrocarbons and carbohydrates. In even the most efficient commercial extraction process, the effluent water from a rubber factory will contain some of each of these materials, together with any chemicals that might have been added to make the process economically more efficient (Ademoroti, 1996(a)). If the waste water is put straight into surface waters – wells, streams, lakes or even the sea - without any treatment, it will inevitably pollute that water (Ademoroti, 1996(b)).

The increasing global concern on the environment demands that wastes should be properly managed in order to minimize and possibly eliminate their potential harm to public health and the environment (Quano *et al*, 1978).

Industrial Waste Water

Some industrial facilities generate ordinary domestic sewage that can treated by municipal facilities. Industries that generate waste water with high concentration of conventional pollutants (e.g; oil and grease), toxic pollutants (e.g; heavy metals, volatile organic compounds) or other non-conventional pollutants such as ammonia, need specialized treatment system. Industrial waste water is the water contaminated due to industrial or commercial activities by human. The cooling water used in the iron and steel industry is contaminated with products such as cyanide and ammonia. Though the waste water produced in the food processing industry is biodegradable and non-toxic, it has high

[1] Associate Professor, Dr, Department of Chemistry, Mawlamyine University
[2] Assistant Lecturer, Department of Chemistry ,Mawlamyine University
[3] Pro Rector, Dr, Sagaing University of Education

concentration of biochemical oxygen demand and suspended solids. In the organic chemical industry, water is contaminated by solvents, cleaning agents, by products and washing or cleaning agents. According to the United States Environmental Protection Agency (EPA), even traces of mercury have been found diluted in industrial waste water (Abedin,1997).

Aim and Objectives

Aim

The main aim of the research work is to investigate the cationic and anionic pollutants of waste water samples and to develop suitable methods for the prevention of waste water pollution released from rubber factories.

Objectives

- To collect the waste water samples from the sampling points of Ever Flow River (EFR) Rubber Factory and Ko Win Ngae, Ma Ni Ni Thein Rubber Factory (No.122, 3rd Street, Shwemyotaw) in Mawlamyine Industrial Zone.
- To determine the pH, EC, TDS, acidity, alkalinity and hardness, chloride, phosphate, silica, sulphate, calcium, magnesium, sodium, potassium, iron, lead, cadmium and chemical oxygen demand (COD) of waste water sample before and after treatment.

Materials and Methods

Collection of Waste Water Samples

Waste water samples were collected from Ever Flow River (EFR) and Ko Win Ngae (KWN), Ma Ni Ni Thein Rubber Factory (No.122, 3rd Street, Shwemyotaw) in Mawlamyine Industrial Zone.

Treatment of Waste Water Samples

Chemicals used for treatment of waste water samples are alum, lime, soda ash and combination of each.

Primary and Secondary Treatment of Waste Water Samples

Waste water samples are allowed to stand overnight. Samples containing suspended matter should be filtered through charcoal, gravel, sand, burnt paddy husk, paddy husk, cotton and filter paper (Whatman No.42).This can only be carried out on clear samples. These clear waste water samples were treated by chemicals (alum, lime, soda ash and combination of each).

Table 1. Methods Used for Determination of Chemical Characteristics of Waste Water Samples

Sr.No.	Characteristic Parameters	Monitoring Methods	Instruments/ Indicators
1	pH	pH-EC-TDS meter	pH-EC-TDS meter
2	EC	pH-EC-TDS meter	pH-EC-TDS meter
3	TDS	pH-EC-TDS meter	pH-EC-TDS meter
4	Acidity	Titration	Phenolphthalein
5	Alkalinity	Titration	Phenolphthalein and methyl orange
6	Total	EDTA complexometric titration	Eriochrome Black-T (EBT)
7	Hardness	Mohr titration	Potassium chromate
8	Chloride	Spectrophotometric method	Spectrophotometer TRST-722
9	Phosphate	Spectrophotometric method	Spectrophotometer TRST-722
10	Sulphate	Spectrophotometric method	Spectrophotometer TRST-722
11	Silica	Atomic Absorption Spectroscopic method	Perkin AAnalyst 80 (Winlab 32 software)
12	sodium	Atomic Absorption Spectroscopic method	Perkin AAnalyst 80 (Winlab 32 software)
13	Potassium	Atomic Absorption Spectroscopic method	Perkin AAnalyst 80 (Winlab 32 software)
14	Calcium	Atomic Absorption Spectroscopic method	Perkin AAnalyst 80 (Winlab 32 software)
15	Magnesium	Atomic Absorption Spectroscopic method	Perkin AAnalyst 80 (Winlab 32 software)
16	Iron	Atomic Absorption Spectroscopic method	Perkin AAnalyst 80 (Winlab 32 software)
17	Lead	Atomic Absorption Spectroscopic method	Perkin AAnalyst 80 (Winlab 32 software)
18	Cadmium COD	Titration	Potassium permanganate

Results and Discussions

Physical Characteristics of Waste Water Samples

Before treatment, physical characteristic of waste water sample (EFR) was observed to be colourless, dirty, turbid and has unpleasant odour whereas that of waste water sample (KWN) was observed to be brown, dirty, turbid and has unpleasant odour. After treatment with alum, lime, soda ash, alum-lime-soda ash, the waste water sample (EFR) became colourless and odourless, showing the effectiveness of these treatments in improving the physical qualities of waste water sample. After treatment with alum and soda ash, the waste water sample (KWN) became pale yellow and odourless, but after treatment with lime,alum-lime, alum-soda ash, lime-soda ash and alum-lime-soda ash, the waste water sample (KWN) became colourless and odourless.

The pH values of the both waste water samples EFR and KWN are found to be within (7.1 to 8.5) and (7.1 to 8.2). These results show that both waste water samples are nearly neutral and slightly alkaline. The EC values of both EFR and KWN are in the range of (0.1 to 17.8 ppm) and (0.2 to 15.1 ppm) respectively. The values indicate that these waste water samples contain low dissolved ions and non-polluted. The TDS values of both EFR and KWN are found to be in the range of (112 to 370 ppm) and (122 to 376 ppm) respectively. These values show that waste water samples contain low dissolved solids.

Before treatment, waste water sample from EFR is found to be very low in acidity (8.8 ppm), but waste water sample from KWN shows very high in acidity (44.0 ppm). The acidity of waste water sample from EFR is fall to ND after physical and chemical treatment. The acidity of waste water sample from KWN falls to 5.28 ppm providing alum-lime treatment is effective in removing acidity. Before treatment, total alkalinity for EFR and KWN are found to be (219.67 ppm) and (234.32 ppm). The total alkalinity of waste water samples from EFR and KWN is fall to (14.65 ppm) and (234.32 ppm) after alum-lime treatment.

The total hardness of waste water sample from EFR before and after treatment is medium soft (50 to 100 ppm). The lowest total hardness is alum-soda ash treatment 56 ppm. So, alum- soda ash treatment is more effective to reduce the total hardness. The total hardness of the waste water sample KWN is also medium soft. The lowest total hardness is alum treatment 70 ppm. Therefore, alum treatment is the most effective operation to reduce total hardness.

The chloride ion concentration of both EFR and KWN are found to be from (6.34 to 15.85 ppm) and from (12.68 to 22.19 ppm) respectively. These values show that waste water sample contains very low chloride ion. The phosphate ion concentration of both EFR and KWN are from (3.56 to 7.73 ppm) and from (4.25 to 8.55 ppm) respectively. These values are greater than that for unpolluted water value of 0.03 ppm. The sulphate ion concentration of both EFR and KWN are from (2.25 to 8.35 ppm) and from (5.39 to 10.13 ppm). These values indicate that waste water samples contain very low sulphate ion concentration.

The silica concentration of both EFR and KWN are found to be in the range from (94.87 to 10.4 ppm) and from (96.75 to 12.57 ppm) respectively. These values show that waste water samples contain very low silica concentration.

The Na^+ and K^+ of EFR are from (7.32 to 33.04 ppm) and from (31.56 to 86.58 ppm). The Na^+ and K^+ of KWN are found to be from (13.82 to 33.04 ppm) and from (86.27 to 86.58 ppm). The range of Ca^{2+} and Mg^{2+} for EFR are found to be from (7.26 to 24.70 ppm) and from (5.81 to 8.80 ppm) and from (7.97 to 9.33 ppm). The iron concentration of both EFR and KWN are found to be in the range from (0.12 to 0.16 ppm) and from (0.14 to 1.64 ppm) respectively.

The lead ion concentration of both EFR and KWN are found to be in the range from (1.15 to 1.40 ppm) and from (1.17 to 1.39 ppm) respectively. These results show that the waste water samples have pollution potential and so need to be treated before discharged to the environment. The cadmium ion concentration of both EFR and KWN are non-detected. The chemical oxygen demand of EFR and KWN are found to be in the range from (1.15 to 1.40 ppm) and from (1.17 to 1.39 ppm) respectively. These results show that the waste water samples have pollution potential and so need to be treated before discharged to the environment. The Cd^{2+} ion concentration of both EFR and KWN are non-detected. The COD of EFR and KWN are from (0.32 to 1.6 ppm) and from (4.8 to 6.08 ppm). These results show that the waste water samples have unpolluted condition.

Table 2. Results of Characterization of Waste Water Samples before and after Tretment Released from Rubber Factories

Parameters	Sample Code No.	EFR	KWN
PH	non – treated	7.2	7.3
	after 1° and 2°	7.4	7.4
	alum	7.2	7.6
	lime	8.5	8.2
	soda ash	7.6	7.4
	alum – lime	7.4	7.1
	alum – soda ash	7.1	7.1
	lime – soda ash	7.2	7.2
	alum – lime – soda ash	7.7	7.1
EC μScm^{-1}	non – treated	0.6	1.3
	after 1° and 2°	0.1	1.6
	alum	1.6	5.0
	lime	17.8	15.1
	soda ash	5.2	2.3
	alum – lime	2.0	1.3
	alum – soda ash	1.1	0.8
	lime – soda ash	0.3	2.1
	alum – lime – soda ash	5.5	0.2
TDS (ppm)	non – treated	155.0	355.0
	after 1° and 2°	159.0	322.0
	alum	183.0	122.0
	lime	370.0	370.0
	soda ash	120.0	272.0
	alum – lime	232.0	159.0
	alum – soda ash	168.0	182.0

	lime – soda ash	153.0	158.0
	alum – lime – soda ash	112.0	244.0
Acidity (ppm)	non – treated	8.8	44.00
	after 1° and 2°	8.8	45.76
	alum	12.32	47.52
	lime	ND	10.56
	soda ash	ND	12.32
	alum – lime	ND	5.28
	alum – soda ash	ND	26.40
	lime – soda ash	ND	15.84
	alum – lime – soda ash	ND	8.80
Total Alkalinity (ppm)	non – treated	92.75	346.59
	after 1° and 2°	82.99	336.83
	alum	122.04	273.37
	lime	87.87	356.36
	soda ash	219.67	351.48
	alum – lime	14.65	234.32
	alum – soda ash	180.62	375.88
	lime – soda ash	19.53	331.95
	alum – lime – soda ash	43.93	327.07

Continue

Parameters	Sample Code No.	EFR	KWN
Total Hardness (ppm)	non – treated	76.00	74.00
	after 1° and 2°	76.00	74.00
	alum	66.0	70.00
	lime	126.00	106.00
	soda ash	58.00	76.00
	alum – lime	84.00	98.00
	alum – soda ash	56.00	78.00
	lime – soda ash	98.00	96.00
	alum – lime – soda ash	94.00	108.00
Chloride (ppm)	non – treated	6.34	15.85
	after 1° and 2°	6.34	15.85
	alum	6.34	15.85
	lime	6.34	15.85
	soda ash	6.34	15.85
	alum – lime	6.34	12.68
	alum – soda ash	15.85	12.68
	lime – soda ash	15.85	22.19
	alum – lime – soda ash	15.85	19.02
Phosphate (ppm)	non – treated	6.38	8.11
	after 1° and 2°	6.21	7.98
	alum	6.13	7.63

	lime	5.98	6.93
	soda ash	7.73	8.55
	alum – lime	4.81	5.83
	alum – soda ash	3.94	5.57
	lime – soda ash	3.56	4.25
	alum – lime – soda ash	7.48	7.81
Sulphate (ppm)	non – treated	8.35	10.13
	after 1° and 2°	8.07	9.54
	alum	6.50	9.18
	lime	5.25	8.76
	soda ash	2.25	8.21
	alum – lime	2.40	7.56
	alum – soda ash	4.70	6.37
	lime – soda ash	2.25	5.39
	alum – lime – soda ash	3.70	6.98
Silica (ppm)	non – treated	9.83	12.57
	after 1° and 2°	9.56	11.42
	alum	6.98	10.57
	lime	4.87	10.80
	soda ash	6.63	9.12
	alum – lime	10.40	6.75
	alum – soda ash	9.31	7.33
	lime – soda ash	6.40	6.98
	alum – lime – soda ash	5.40	8.55

Continue

Parameters \ Sample Code No.		EFR	KWN
Sodium (ppm)	non – treated	7.32	13.82
	after 1° and 2°	9.31	14.60
	alum	13.42	15.77
	lime	10.54	15.08
	soda ash	33.03	33.04
	alum – lime	14.88	20.06
	alum – soda ash	32.47	33.04
	lime – soda ash	33.04	33.04
	alum – lime – soda ash	30.65	33.04
Potassium (ppm)	non – treated	31.56	86.57
	after 1° and 2°	64.37	86.54
	alum	86.32	86.27
	lime	69.80	86.53
	soda ash	71.20	86.52
	alum – lime	86.41	86.28
	alum – soda ash	86.41	86.40
	lime – soda ash	86.58	86.58

	alum – lime – soda ash	86.40	86.38
Calcium (ppm)	non – treated	14.58	7.42
	after 1° and 2°	12.90	9.82
	alum	11.77	8.73
	lime	24.70	29.33
	soda ash	8.26	7.86
	alum – lime	21.89	7.85
	alum – soda ash	7.41	7.06
	lime – soda ash	7.26	9.95
	alum – lime – soda ash	15.17	11.60
Magnesium (ppm)	non – treated	8.12	9.15
	after 1° and 2°	8.80	9.33
	alum	8.40	8.83
	lime	8.21	8.80
	soda ash	8.23	9.01
	alum – lime	7.83	8.57
	alum – soda ash	7.91	8.68
	lime – soda ash	5.81	8.20
	alum – lime – soda ash	7.44	7.97
Iron (ppm)	non – treated	0.16	1.64
	after 1° and 2°	0.14	1.37
	alum	0.12	0.72
	lime	0.14	0.14
	soda ash	0.15	0.93
	alum – lime	0.13	0.95
	alum – soda ash	0.13	0.84
	lime – soda ash	0.13	0.21
	alum – lime – soda ash	0.14	0.19

Continue

Parameters / Sample Code No.		EFR	KWN
Lead (ppm)	non – treated	1.40	1.39
	after 1° and 2°	1.36	1.38
	alum	1.15	1.17
	lime	1.20	1.24
	soda ash	1.17	1.21
	alum – lime	1.21	1.23
	alum – soda ash	1.28	1.25
	lime – soda ash	1.28	1.32
	alum – lime – soda ash	1.34	1.34
Cadmium (ppm)	non – treated	ND	ND
	after 1° and 2°	ND	ND
	alum	ND	ND
	lime	ND	ND

	soda ash	ND	ND
	alum – lime	ND	ND
	alum – soda ash	ND	ND
	lime – soda ash	ND	ND
	alum – lime – soda ash	ND	ND
COD (ppm)	non – treated	0.8	5.12
	after 1° and 2°	0.96	5.44
	alum	0.32	4.80
	lime	0.64	5.60
	soda ash	0.48	5.28
	alum – lime	0.96	4.96
	alum – soda ash	0.96	4.96
	lime – soda ash	1.60	6.08
	alum – lime – soda ash	1.28	5.92

Conclusion

The results of characterization of this water effluent show that the waste water has high pollution potentials and so need to be treated before it is released into the environment. Generally, alum-lime is the most effective treatment for these waste water samples. The waste water could therefore be discharged safely without the fear of pollution after alum-lime treatment.

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