

WASTE WATER FROM RAW RUBBER PROCESSING INDUSTRY IN SRI LANKA AND RELATED ENVIRONMENTAL ASPECTS

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INTRODUCTION

Natural rubber is one of the three major crops in Sri Lanka grown over 160,000 hectares of land in major rubber growing districts namely Kalutara, Kegalle, Ratnapura, Gampaha and Galle. In addition to being one of the major economic crops, it also strengthens the natural forest cover (40% of the land) of the country thereby contributing towards continuity of environmental balance. However various planting practices and processing of the raw material are known to cause an impact on environmental balance in the rubber plantation at varying degrees. The most noticeable effect is caused by factory effluents which contain a large amount of non rubber substances in addition to traces of various processing chemicals. The unpleasant odour caused by factory effluent has become an environmental problem in several estates and the affected waterways of the country by factory effluents has aroused significant public concern. There are a large number of raw rubber processing factories in Sri Lanka which are equipped with facilities to produce one or more of the following grades of rubber.

	No. of factories (app.)
(1). Crepe and sole crepe	150
(2). Ribbed Smoked Sheets	50
(3). Technically Specified Rubber(TSR)	4
(4). Centrifuged latex processing centres.	12

It is estimated that about 3 - 4 million metric tonnes of effluent per year has been produced by these factories during the last 10 years with sheet rubber and crepe rubber processing being the higher contributors.

Production of raw rubber and effluent in 1990 is given in table (1).

Table 1. *Production of Raw Rubber and the amount of effluent (Appr.) 1990*

Grade	Production x 1000 kg	kg of effluent per kg of rubber produced	Effluent produced MT
RSS	56356	25	1.4
Crepe & Sole crepe	36191	50	1.8
TSR	9893	20	0.1
Scrap crepe	5803	35	0.203
Centrifuges latex	4803	10.5	0.05
Total	13103	140.5	3.153

The amount of factory effluent produced in latex concentrate factories has been increasing steadily during the last few years with the emergence of several new factories to produce latex concentrate due to growing demand locally for various rubber based industries.

Survey on environmental effects

Dr P A J Yapa (RRISL, 1984) has carried out an islandwide survey to assess the extent of pollution problem due to rubber factory discharge into streams in the country.

According to the findings of the survey, of the total number of estates 52 responded to survey, 59.6% of the estates had pollution problem within their estate or outside the estate or both, 22.6% estates had received complaints within the estate and 48.4% received complaints from outside the estates, *i.e.* from villagers *etc.*, 22.6% of the estates had received complaints from both within the estate and outside and 6.5% had pollution problem but received no complaints from anybody.

Of the total number of Group Processing Centres 48 responded to survey, 70.8% of the GPCs had pollution problems 39.5% of the GPCs (19) had received complaints from the villagers. One interesting factor in the smallholder sector was that although many of the GPCs had pollution problems, those were affected did not complain as they themselves were members of the GPC and seem to think it would not be fair to complain against their own GPC.

Unlike in the estate sector where the factories are normally situated away from any major residential area except for few places, the GPCs are mostly located close to residential areas, public roads, villages markets *etc.*

Method of effluent disposal

According to the findings previously, only 7 estates had some kind of treatment facility for treatment of their factory effluent before disposal.

Most estates (73.1%) discharge their effluents into nearby streams. 9.6% of the estates discharge their effluents into paddy fields, 13.5% estates in to both paddy fields and streams. 1.9% estates into paddy fields through a desert area or vice versa. Only few estates discharge their effluents into a major river.

None of the GPCs had any treatment system for effluents. In fact most (of them had never heard of such treatment methods. Most of the GPCs (37.5%) discharge their effluents into paddy fields.

Rubber effluent characteristics

Rubber processing effluents mostly contain non rubbers such as carbohydrates (Sugar, starch, cellulose), lipids (fats and oils, Grease), enzymes, proteins (high molecular weights compounds of Amino acids) and uncoagulated rubber hydrocarbons to a certain extent and generally has the following chemical composition.

Approx. Percentage(%)

(1). Carbohydrates Methyl Inositol)	=	2.3
(2). Proteins	=	1
(3). Free Amino acids	=	0.018
(4). Other organic acids	=	0.04
(5). Nitrogeous bases(choline methyl amine	=	0.08
(6). Inorganic anions (PO_4^{3-} , CO_3^{2-})	=	trace amounts
(7). Metallic ions (K^+ , Mg^{2+} , Fe^{2+} , Na^+ , Cu^{2+}	=	-do-
(8). Formic Acids (used for latex coagulation)	=	0.012

Effluents from latex centrifuging factories are known to have a much higher levels of organic content than those released by crepe rubber and sheet rubber producing factories. The following chart shows the average characteristics of effluents generating from various types of NR processing industries. Regulatory Standards stipulated by the CAE for effluent water at the point of discharge is also indicated alongwith.

Average effluent quality parameters of effluent generating from various type of raw rubber processing and CEA standards

Parameter	RSS	Crepe	TSR	Latex Concentrate	Dipped products	Regulatory Standards
pH	4.9	5.0	5.7	3.7	7.2	6.5-8.5
Settleable solids	50	45	155	100	200	
Suspended solids	140	130	237	190	241	100
Total solids	3745	3500	1915	7576	2457	1500*/1000
C.O.D.	3300	3500	2740	6201	2011	400
B.O.D.	2630	2500	1747	3192	1336	50/60*
Ammoniacal nitrogen	75	80	66	401	126	300*/40
Total nitrogen	500	550	147	616	180	300*/60
Sulphates				1610	72	1000

*CEA standards Centrifuged latex processing effluent (All values are in mg/l except for pH)

Effects of effluents on soil pH

The effect of rubber factory effluents on soil pH has studied by Dr. Yapa (1980). With exceptions of few places, the pH of this affected soil was found to be high compared to unaffected soil. The mean pH of the unaffected areas was 5.1 whilst that of affected areas was 6.0. He has confirmed that these findings were in accordance with his previous findings.

Long term effect of rubber effluents on soil nutrient levels

Mean percentage increase in soil nutrient level in certain areas in the estate sector which had been exposed to rubber effluents as long as 20 years is given in the following table.

Nutrient	Nutrient level/ppm		
	Unaffected	Affected	% increase
N	1501.4	2272.6	51.4
P	59.2	271.2	358.1
K	43.91	191.0	254.98
Na	4.51	6.23	7.75
Ca	188.3	315.6	67.6
Mg	28.45	53.83	89.2

The levels of all the Nutrients tested were again higher in affected soils than unaffected soils. The increase in P and K were as high as 358 and 255 percent respectively. The common belief of paddy field owner where paddy field had been exposed to effluent over so many years is that rubber serum is beneficial for the growth of the plant but has no such effect on the harvest. The reason for this has not been studied at length. However, Rubber serums has been found to be very good fertilizer for leafy vegetables, plantation trees etc.

Therefore, long term exposure of soils to rubber factory effluents is of great interest. However, mal odour emanating from such areas is quite evident and as a result creates a certain amount of air pollution in these areas. Hence, land application of effluent continuously over a large period to one place may not be advisable particularly in places where people living in the vicinity. However intermittent land application of effluent would undoubtedly has advantages and that it would act as a fertilizer.

A similar trend was observed in paddy soils too. In particular areas where paddy soil has been affected by rubber serum for more than two decades the pH of the soil had increased from 4.61 to 5.24 due to factory effluents.

Fertilizer value of factory effluents

Rubber serum phase of latex is known to constitute about 70% of the total volume and contains large number of micro and major nutrients required for plant growth.

Rubber serum is fully rich in nitrogen (N), phosphorous (P) and potassium (K).

On a colonial basis, the N and K contents of PB 86 the most widely grown clone in Sri Lanka particularly at small holder level were found to be higher than those of other clones. The amounts of nutrient contained in rubber factory effluents in Sri Lanka are given in the following tables.

Type of effluent	Mean concentration of nutrients (mg/)			
	N	P	K	Mg
Latex concentrate	563	60	386	44
TSR	95	20	47	13
Conventional grades (crepe & RSS)	230	87	280	56

Total rubber effluent nutrients

Nutrient	MT/Year	PB 86 clone MT/Year
N	217	374
P	224	107
K	258	693
Na	31	
Ca	29	
Mg	127	

CONCLUSION

Impact on environment due to rubber factory effluent discharge, apparently has positive and negative effects as could be seen from the findings reported in this paper. Controlled release of effluents on soil could be considered as a slow addition of nutrients into soil while untreated effluent discharge into streams would create mal odour and pollution. It was also observed that rubber effluent did not contain any toxic substances. As such rubber factory effluents should be treated to achieve the quality of the effluent which will be suitable to discharge into streams. since there are no toxic substances present in NR processing effluent, treatment could be achieved by biological environmentally friendly process. High rate anaerobic/aerobic system developed by the RRI is a cost effective way of achieving this target. Diagram is given in the figure 1. Sludge (live and dead bacteria) that gets accumulated as a result of Aerobic treatment is regarded as a good manure for plants.

FLOW DIAGRAM OF TREATMENT PLANT

