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Environmental Impact of Rice Mills on Groundwater and Surface Water

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Abstract: **Parboiled rice is one of the most popular rice produts. The process of parboiling involves soaking, steaming and drying and this production requires large amount of water for soaking the paddy. The soak water contains large quantity of organic material and when discharge large quantities of soak water repeatedly over a localised area where it stagnates and putrifies causing pollution of water and groundwater. This study will mainly focus on the effect of rice mills on groundwater at Okkal and Periyar river near Okkal. The groundwater present in the study area are polluted due to release of waste water from rice mills. To find out the extent of pollution, various water quality parameters such as Alkalinty, Iron, Hardness, Chloride, Acidity, BOD, COD, Dissolved Oxygen and Sulphate were studied. It has been found that the parameters such as Iron, Dissolved Oxygen, BOD and COD are not in the acceptable limit in accordance with the IS 10500 drinking Water Quality Standards.**

Keywords: **Ground water, Okkal, Rice mills, Surface water.**

I. INTRODUCTION

Water is indispensable and one of the precious natural resources of our planet. Ground water is an important natural source of water supply all over the world. Its use in irrigation, industries and domestic usage continues to increase where perennial surface water source is absent. The modern civilizations, over exploitations, rapid industrialization and increased population have lead to fast degradation of our environment. To meet the rising demand, it is imperative to recognize the fresh water resources and also to find out remedial methods for improvement of water quality. The quality of groundwater may depend on geology of particular area and also vary with depth of water table and seasonal changes and is governed by the extent and composition of dissolved salts depending upon the source of the salt and soil subsurface environment. Water intended for human consumption should be safe and wholesome that is free from pathogenic agent and harmful chemicals, pleasant to taste and useable for domestic purpose. In the context of quality and quantity, groundwater fluctuates in variably in its own which reflects the time to time status of groundwater as a whole for the region.

Industrial activity affects the environment directly or indirectly. Environmental emission from any industry has impact on air, water and land. It is very much necessary to increasing awareness of the fact that clean environment is necessary for smooth living and better health of human beings. Primary milling of rice is the most important activity in food grains. Due to industrialization and global competitive market trends, it has emerged as major industrial activity in small medium sector to cater the needs of increasing population. There are huge number of mills engaged in processing of rice and are spread over in almost all state across the country due to increasing trends. Rice milling is the process of removing the husk and part of the bran from paddy in order to produce the rice for eating. Parboiled rice production generally requires huge amount of water for soaking of the paddy. Waste water coming from rice mill operations contains high concentration of organic and inorganic substance causing significant polluting phenomena. The aim of this study is to understand the extent of water pollution due to the effluents from rice mill.

II. LITERATURE REVIEW

Treatment of wastewater from parboiled rice mill unit, a research paper published in International Journal of Life Sciences Biotechnology and Pharma research by S R Asati.Shri Sai Baba Rice mill,Kudwa,Gondia was selected for wastewater

analysis. For characterization, various parameters like pH, alkalinity,BOD, COD,TS, SS of the wastewater were determined as per the standard methods of analysis of water and wastewater. The characterisation of wastewater shows that wastewater is highly biodegradable as is seen from BOD/COD ratio (0.8) ,however it is highly odors and coloured and needs treatment.

effect of rice mill wastewater on population, biomass, rate of production and secondary production of Drawida Wiilsi in rice field agrosystem published in IJRRAS 6 FEBRUARY 2011 BY Abanti Pandhan and Sanjat K.Sahu. The work was carried out near a rice mill, which is 5km away from Sambalpur Universuty Campus, Orissa. The effluent of rice mill industry showed an alkaline pH with low concentration of DO, nitrate, phosphate and sulphate and moderate concentration of COD, chloride and TDS. The total suspended solids and BOD were much higher than the recommended standard set by ISI. The effluent was rich in sodium, total phenols as well as silica. The higher values of phenolic and silica in the effluent is perhaps because of boiling and cleansing operations involved during processing of raw paddy.

Enhancing sustainability of local rice mills by cleaner production and industrial ecological principles published in ICSBE DECEMBER 2010 by H.M.A.P Rathnayake1*, A.K. Kulatunga2, T.M.R. The work carried out in Sri Lanka because 70 percent of the paddy produced in Sri Lanka at present is parboiled. Two dominant wastages are released to environment in parboiled rice milling namely, soak water and paddy husks. For one metric ton of paddy, approximately 1.3 m3 of soaked water and 0.2 tons of paddy husk are released to environment and soaked water is discharged to the environment without being treated. Due to this, bad odour is prevailed in the vicinities of the mills. In addition, paddy husk and ash dumps are washed away with rain to the waterways. To minimize bad smell, millers are advised to change socking every 10-12 hours. Even though socking water is changed every 12 hours time COD and BOD5 levels of releasing water are higher than the values set by CEA. Therefore, sustainability of this industry relies addressing the waste streams in a productive manner. Therefore they cleaner production principle is adapted to minimize the waste generated by attacking the point of generation and using potion of treated wastewater for soaking process.

Environmental protection agency in Washington studied the grain milling industry and they found that the water used in parboiled rice mill is very large and it varies from about 1.4-2.1cum/kg and additional water used in boilers for steam production. Commonly the waste water from parboiled rice mill contains the following characteristics such as BOD, COD, Total solids, Dissolved soilds, Nitrogen and Iron contents.

III. STUDY AREA

The Okkal Panchayat is located in the Ernakulam district of Kerala. The latitude 10.1497152°N and longitude 76.4516101°E are the geocordinate of the Okkal. It has approximately 5000 houses from 16 wards. There are several industries such as timber, steel, ply-wood etc and around 28 rice mill. Many rice mills are located near the Periyar river. The total population is around 22148 and almost 90% is depending open wells for drinking water.

IV. SAMPLING AND METHODOLOGY

The preliminary survey on the quality of groundwater was conducted in the beginning of December 2014.For groundwater analysis, the water samples were collected from15 open wells and analyzed various water quality parameters. The samples were collected from wells located within 1 km around a rice mill at Chelamattom part of Okkal panchayath. These samples were collected by the end of December. Samples are numbered as 1, 2, to 15, in such a way that sample 1 is closest to the mill and sample 15 is farthest from the rice mill.

The waste water from the rice mill is discharged to Periyar river at Vallom region. For surface water analysis, the water samples were collected from the river approximately 50 km upstream (U-50)and 25 km(D-25) and 50 km(D-50) downstream of discharge point and at the discharge point(P) itself and analyzed various parameters and compare the variations in the values. These samples were collected in the beginning of January. Two litres of samples were collected for the analysis. The water quality parameters analyzed are iron, alkalinity, hardness, DO, BOD ,COD, chloride and sulphate.

Table: 1. Drinking Water Standards given by BIS

SL No:	Parameters	Permissible Limit
1	Alkalinity (mg/L)	120
2	Hardness (mg/L)	300
3	Chloride (mg/L)	250
4	Iron (mg/L)	0.3
5	DO (mg/L)	5
6	Acidity (mg/L)	37
7	COD (mg/L)	255
8	BOD (mg/L)	30
9	Sulphate (mg/L)	150

Table: 2. Observed values of groundwater samples

Sample	Alkalinity	Hardness	Chloride	Iron	DO	Acidity	COD	BOD	Sulphate
1	60	40	54.59	0.9	4	25	1184	704	23
2	46	38	25.80	0.75	4.3	9	1002	601.2	21
3	72	24	19.85	0.7	4.3	20	950	570	11
4	32	18	15.38	0.7	5	32	904	542.4	15
5	12	16	19.85	0.6	5.5	16	912	547.2	7
6	8	10	26.80	0.55	6.5	21	809	485.4	25
7	18	15	18.86	0.6	7	10	750	450	15.5
8	14	20	18.36	0.5	7.4	15	631.02	378.7	16.5
9	20	13	20.84	0.4	7.4	34	542.05	325.5	16
10	25	20	28.78	0.5	7.2	18	602	361.2	12
11	12	15	19.85	0.35	7.5	20	448	268.8	13.5
12	18	10	15	0.3	7.6	17	384	230	19
13	24	8	13.36	0.3	7.6	36	298	178.8	14
14	22	10	9.9	0.2	7.8	22	240	136	16
15	10	8	18.36	0.2	8.5	26	222	123.4	20

All values are expressed as mg/L

Table: 3 Observed values for surface water samples

Sample	Alkalinity	Hardness	Chloride	Iron	DO	Acidity	COD	BOD	Sulphate
U-50	12	15	8.44	0.25	7	28	222.8	133.68	8.5
P	24	22	36.72	2	4.5	20	728	436.8	15.5
D-25	38	36	17.37	0.75	6.5	24	456	273.6	3.5
D-50	20	24	26.80	0.35	6.8	16	324	195.6	17.5

All values are expressed as mg/L

V. RESULTS AND DISCUSSIONS

The analytical results obtained for different study parameters such as Alkalinity, Hardness, Chloride, Iron, DO, Acidity, COD, BOD and Sulphate from different sampling locations of groundwater and surface water is summarized in table 2 and 3 respectively. Permissible limit given by BIS is described in table 1. The results obtained for different samples are discussed below.

The total alkalinity in groundwater samples varies from 8 mg/L to 72 mg/L and surface water samples it varies from 12 mg/L to 38 mg/L. The values are within the permissible limit. The total hardness varied between 8 mg/L to 40 mg/L in groundwater samples and 12 mg/L to 38 mg/L in surface water samples. In all samples the total hardness is within the IS 10500 standards. Chloride concentrations in all the samples ranged between 9.9 mg/L to 54.59 mg/L in groundwater samples and 8.44 mg/L to 36.72 mg/L in surface water samples. The total chlorides observed are below the permissible limit.

The iron varies from 0.9mg/L to 0.2mg/L for groundwater samples. It is maximum for sample 1 and minimum for sample 14 and 15. It was found to be greater than permissible limit for 73% of the samples collected. In surface water samples, sample P has iron content 2mg/L, but sample U-50 has only 0.25mg/L. Generally waste water does not have DO; its presence in untreated waste water indicates that the waste water is fresh. It ranges from 4mg/L to 8.5 mg/L. Only samples 1, 2 and 3 are below the permissible limit. The sample in the upstream of point of waste water discharge has DO 7mg/L, but the discharge point has only 4.5 mg/L. As per standards, the DO should not be less than 5mg/L. The acidity ranges from 9 mg/L to 36 mg/L in groundwater samples and 16 mg/L to 28 mg/L in surface water samples. The permissible limit is 37 mg/L. Hence all samples are within permissible limit.

Almost all samples have COD value more than the standards in which the sample 1 has 1184 mg/L, but sample 15 has only 222 mg/L. For surface water samples, sample P has COD 728 mg/L, but U-50 has only 222.8 mg/L. Very high value of COD have been reported from rivers which receive domestic and industrial wastes. However the COD values in the present study are above the permissible limits. BOD also shows a similar variation as that of COD. The sample 1 has 704 mg/L and sample 15 has 123.4 mg/L. All samples are greater than the standards. In surface water sample, sample U-50 has only 133.68 mg/L but sample P has 436.8 mg/L. The permissible limit of sulphate in drinking water is 150 mg/L. The range of sulphate in groundwater varies from 7 mg/L to 23 mg/L and in surface water it varies from 3.5 mg/L to 17.5 mg/L. All values are within the permissible limit.

VI. CONCLUSION

Water is a vital commodity for the survival of human beings, animals and vegetation and for the proper balance of the ecosystem itself. Any adverse impact on water quality due to the industrial activity will have consequences on the environment.

The production of parboiled rice involves soaking, steaming and drying and this production requires large amount of water for soaking of the paddy. The soak water contains organic material and when discharge large quantities of soak water repeatedly over a localized area where it stagnates and putrifies, causing pollution of water and groundwater, so the effluent should be properly treated before disposal as it may contaminate groundwater.

From the tests conducted above, the values obtained for hardness, chlorine, sulphate and alkalinity for all samples ie, well samples as well as surface water samples are within the permissible limits. But the values of iron, DO, BOD and COD are not within the acceptable limits. The iron and DO showed lower variations from the permissible limits, but COD and BOD shows higher variations. In case of well water samples, higher values are at the near areas to the rice mill. Also, for surface water samples highest values are at the discharge point and downstream when comparing with the upstream sample. So it is apprehended that surface water as well as groundwater may get polluted by the waste water from the rice mill and not suitable for drinking considering iron, BOD, COD and DO as criteria.

Even though the rice mills discharge waste water after treatment, also shows variations in some parameters from standards, so it is conformed that the treatment is not effective and they need to go for better treatment before disposal. However the study was confined to the determination of only few characteristics and that too over a short period. So to arrive at a better conclusion a long term study with more parameters is necessary to be analyzed.

REFERENCES

[1] APHA (1995). Standard method for the examination of water and waste water, APHA, Washington DC.

[2] BIS 10500,(1991) Specifications for drinking water, Indian standard Institution (Bureau of Indian Standards), New Delhi.

[3] WHO (1992), International Standards for Drinking water. World Health Organisation, Geneva, Switzerland.

[4] S R Asati, Treatment of Waste Water from Parboiled Rice Mill Unit by Coagulation/ Flocculation. International Journal of Life Sciences Biotechnology and Pharma Research, ISSN 2250-3137.

[5] P.N. Patali, D.V. Sawant, R.N. Deshmukh, Physico-chemical parameters for testing of water. A review , International Journal of Environmental Sciences, 3, 1194-1207

[6] R. Manogari, D. Daniel, A. Krastanov, Biodegradation of Rice Mill Effluent by Immobilised PSeudomanas SP. Cells. Ecological Engineering and Environment Protection, No 1, 2008, pp 30-35.

[7] Chemistry for Environmental Engineering- Sawyer and Mc Caurty, Tata Mc. GRAW-HILL.

[8] S.K. Garg, Water Supply Engineering.

[9] Abanti Padhan, Sanjat k Sahu, Effect of Rice Mill Waste Water on Drawida Willsi.IJRRAS 6 (2).February 2011.