

## Evaluation of Rice Husk and Rice Husk Ash as Natural Coagulant

Anjali.K. Ullas

*Malabar College of Engineering and Technology, Kerala Technological University,  
Desamangalam, Kerala*

---

**Abstract:** One of the major sources, which contaminate the environment is the waste water produced from various human activity. At present, in order to decrease waste hazards and to restrict the resulted effects on the environment, investigators are studying the possibility of using new methods and materials to treat waste water and reuse. Various methods are widely used in the treatment of wastewater such as coagulation and flocculation process. Today, the prime concern of the environmental engineers is how to lower the coagulants and flocculants cost and to improve the characteristics of the produced sludge as more environment friendly for safe utilization. This project presents the usage of natural materials (rice husk ashes and non ashes) as coagulants to treat the dairy waste water to reduce its turbidity. The initial dairy waste water characteristics are tested for both physical and chemical properties like color, pH, turbidity, BOD<sub>3</sub>, COD, TSS and TDS. Then the sample is treated with natural coagulant and allowed for different settling times (30 min and 60min). Later the water is filtered and tested for various physical and chemical parameters and the variations in the properties are noted. Comparative analysis has done for coagulation in varied settling time and dosage. Better efficiency at an optimum dosage and pH was resulted. After verifying the final characteristics with respect to permissible standards for various uses, the water can be reused.

**Keywords:** Coagulation, Ricehusk, Rice husk ash, Turbidity

---

### 1. Introduction

Global environmental pollution is one of the major issues, increasing earth day by day. Dairy is one of the major agriculture industries and dairy wastewater problem is larger in developing countries because all milk is processed industrially. The effluent discharged by raw milk quality control laboratories are more complex than the ones commonly generated by dairies factories because of the presence of the certain chemicals sodium azide or chloramphenicol which are used for preserving milk before analysis. The environmental impact of these factories can be very high, especially due to the discharge of very large wastewater with high content of organic matter and nutrients (nitrogen and phosphate). Dairy is having particular characteristics of effluents and hence has the different effluent related problems. The high BOD and COD values obtained by the analysis of dairy effluents indicate the presence of heavy load of organic substances. It is very important that proper waste water treatment systems should be installed. Coagulation is an essential process in the treatment of both surface water and industrial wastewater. Its application includes removal of dissolved chemical species and turbidity from water via addition of conventional chemical-based coagulants, namely, alum (AlCl<sub>3</sub>), ferric chloride (FeCl<sub>3</sub>) and poly aluminum chloride (PAC).The disadvantages associated with usage of these coagulants such as ineffectiveness in low-temperature water, relatively high procurement costs, detrimental effects on human health, production of large sludge volumes and the fact that they significantly affect pH of treated water. It is therefore desirable to replace these chemical coagulants with naturally obtained materials as coagulants to counteract the drawbacks .The usage of agro waste materials (ashes and non ash) to treat the turbid water for reuse is described in this project

#### 1.2 Significance of natural coagulants

Now a day due to rapid industrialization even in rural areas, water become contaminated. Presently there are no appropriate low cost methods available for removal of water contaminants from drinking water. There are a variety of purification methods of drinking water which are very costly and those methods cannot serve a common man effectively. The use of natural coagulant is one of best method for water clarification. In order to overcome the problems caused by chemical coagulants, it is very necessary to use the natural coagulants. Because they are eco friendly, cost effective, safer and also helpful for achieve water quality standards. The material have to be used in powder form for water treatment which may offer a practical, inexpensive and appropriate for reusing the waste water. This project focuses on evaluation of rice husk and rice husk ash as a natural coagulant for treating the dairy waste water.

## 2. Methodology

### 2.1 Materials

The coagulant which is used is rice husk and rice husk ash for treatment of dairy waste water. The rice husk was brought from rice mill situated in Athani, Thrissur. The approximate composition of rice husk and rice husk ash is given in figure 1. Dairy waste water has been collected from Milma Dairy in Thrissur which is shown in figure 2.

Composition	Percentage
Cellulose	31.12
Hemicellulose	22.48
Lignin	22.34
Mineral ash	13.87
Water	7.86
Extractives	2.33
Chemical analysis of mineral ash	
SiO <sub>2</sub>	93.19
K <sub>2</sub> O	3.84
MgO	0.87
Al <sub>2</sub> O <sub>3</sub>	0.78
CaO	0.74
Fe <sub>2</sub> O <sub>3</sub>	0.58

Figure 1: Composition of rice husk and rice husk ash



Figure 2: Color of dairy waste water

### 2.2 Methods

#### 2.2.1 Preparation Of natural coagulants

Rice husk from nearby rice mill was collected and washed using distilled water. The washed rice husks were sun dried for several hour till it completely loses the moisture content present in it. And this rice husk is placed in a muffle furnace at 500°C for 1 hour for converting it into ash. Rice husk and rice husk ash was sieved through 300µm sieve. Figure 3 and 4 shows the rice husk and rice husk ash.



Figure 3: Rice husk



Figure 4: Rice husk ash

#### 2.2.3 Experimental Work

The jar test apparatus has been used for coagulation shown in figure 5. The jar test apparatus has the five beakers and five steel paddles which helps in the agitation process. The initial speed of agitation is 100rpm for 1 min, followed by 40rpm for 30min. The settling time applied for coagulation process are 30 min and 60 min. Color, Turbidity, pH, COD, BOD, Total dissolved solids, Total suspended solids are taken into account to determine the initial characteristics of dairy waste water using standard laboratory tests. After treating dairy waste water with natural coagulant rice husk and rice husk ash, specified settling period, then filtration is carried out through filter paper. The optimum dosage for the coagulant is determined and the same tests are repeated

such determination of Color, optimum pH, COD, BOD, TDS, TSS, turbidity with the optimum coagulant dosage treated water sample.



**Figure 5:** Jar test apparatus

### 3. Results and Discussions

#### 3.1 Raw Water Characteristics

The initial characteristics of dairy waste water such as Color, pH, Turbidity, BOD, COD, Total suspended solids, Total dissolved solids were determined and it is shown in table 1.

**Table 1:** Initial characteristics of collected water

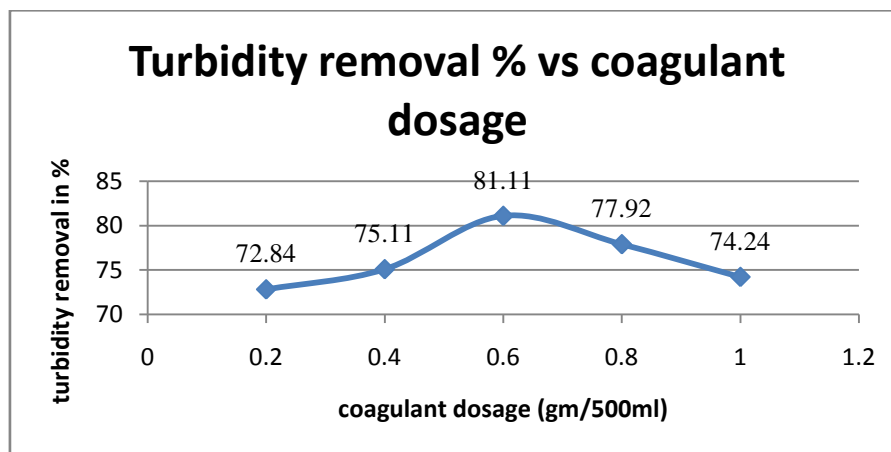
Sl.No	Parameters	Units	Initial value
1	Color	-	Grey
2	pH	-	6.06
3	Turbidity	NTU	220.2
4	BOD <sub>3</sub>	mg/l	2510.0
5	COD	mg/l	4300.0
6	TSS	mg/l	2520.0
7	TDS	mg/l	3480.0

### 3.2 Optimum dosage

The optimum dosage of coagulants are determined by adding various the dosage of coagulant such as 0.2gm, 0.4gm, 0.6gm, 0.8gm, 1.0gm in 500 ml dairy waste water at original pH of dairy wastewater (pH =6.06). Turbidity value after 30 min and 60 min,pH variation by using the rice husk and rice husk ash with different dosage is shown in table 2.The coagulant dosage in which turbidity level is decreased is considered as the optimum dosage. The optimum coagulant dosage adopted for natural coagulant rice husk and rice husk ash is 1.2 gm/l (0.6 gm in 500 ml). Figure 6 and 7 shows turbidity removal efficiency after settling of 30 min and 60 min respectively using Rice husk. Figure 8 and 9 shows turbidity removal efficiency after settling of 30 min and 60 min respectively using Rice husk ash. As the time of settling increases turbidity removal efficiency also hasincreased.

**Table 2:** Initial characteristics of dairy water

Sl.No	Coagulant Dosage (gm)	Rice husk as coagulant			Rice husk ash as coagulant		
		Turbidity after 30 min (NTU)	Turbidity after 60 min (NTU)	pH	Turbidity after 30 min (NTU)	Turbidity after 60 min (NTU)	pH
1	0.2	59.8	36.8	6.7	38.6	28.1	6.8
2	0.4	54.8	32.5	6.9	34.8	23.3	6.9
3	<b>0.6</b>	<b>41.6</b>	<b>28.7</b>	<b>7.2</b>	<b>26.1</b>	<b>11.9</b>	<b>7.1</b>
4	0.8	48.6	30.2	7.4	28.5	18.9	7.3
5	1.0	56.5	34.2	7.4	35.4	25.3	7.3



**Figure 6:** Turbidity removal efficiency after settling of 30 min using Rice husk

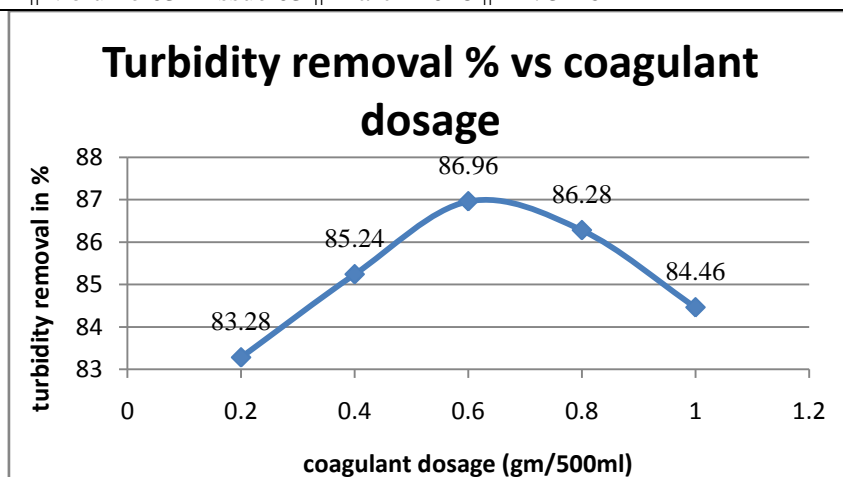


Figure 7: Turbidity removal efficiency after settling of 60 min using Rice husk

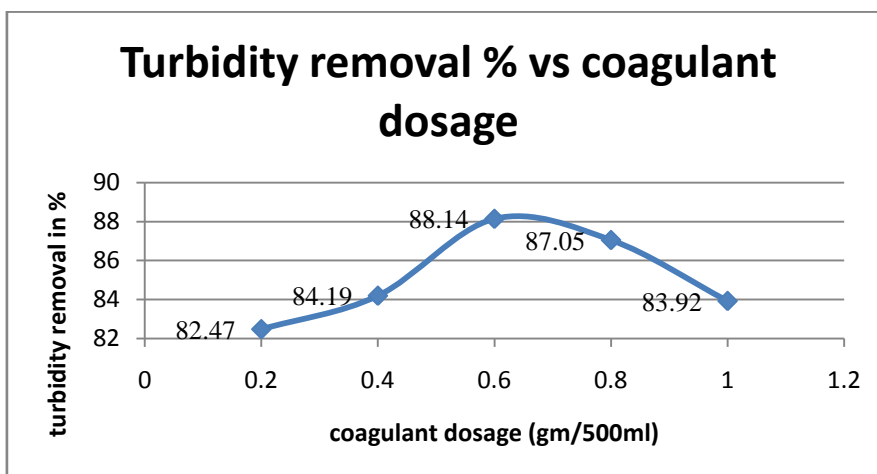


Figure 8: Turbidity removal efficiency after settling of 30 min using Rice husk ash

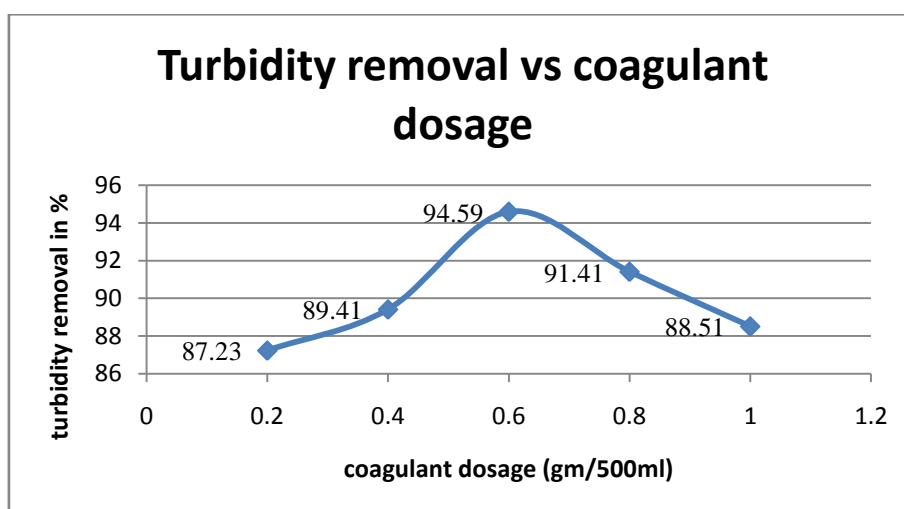


Figure 9: Turbidity removal efficiency after settling of 60 min using Rice husk ash

### 3.3 Optimum pH

Optimum pH is the pH at which the maximum reduction of turbidity takes place. The pH value varies in the range of 6.7, 6.9, 7.2, 7.4, and 7.4 in the case of using Rice husk. The optimum pH adopted for natural coagulant Rice husk is 7.2. The pH value varies in the range of 6.8, 6.9, 7.1, 7.3, and 7.3 in the case of using Rice husk ash. The optimum pH adopted for natural coagulant Rice husk ash is 7.1. Figure 10 and 11 shows the optimum pH after settling of 60 min using rice husk and rice husk ash respectively.

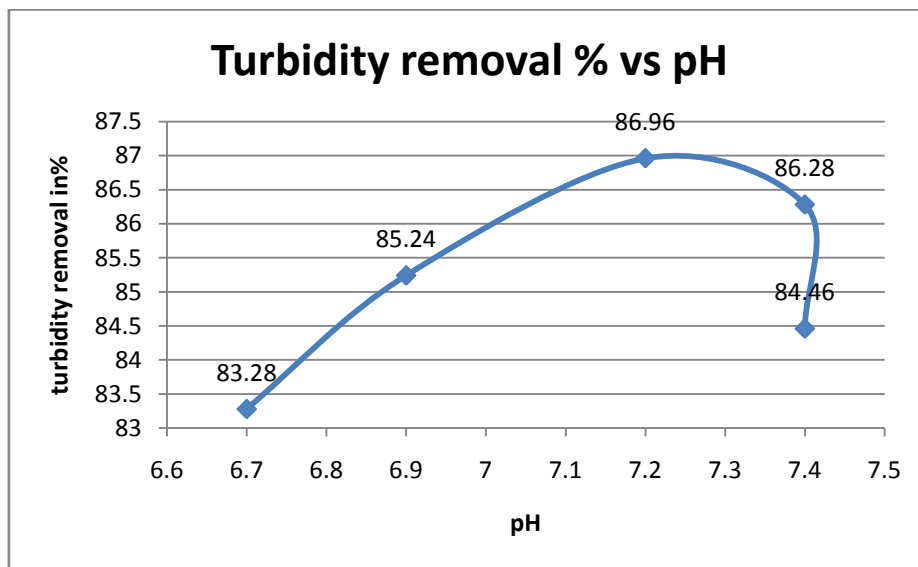


Figure 10: Optimum pH after settling of 60 min using Rice husk

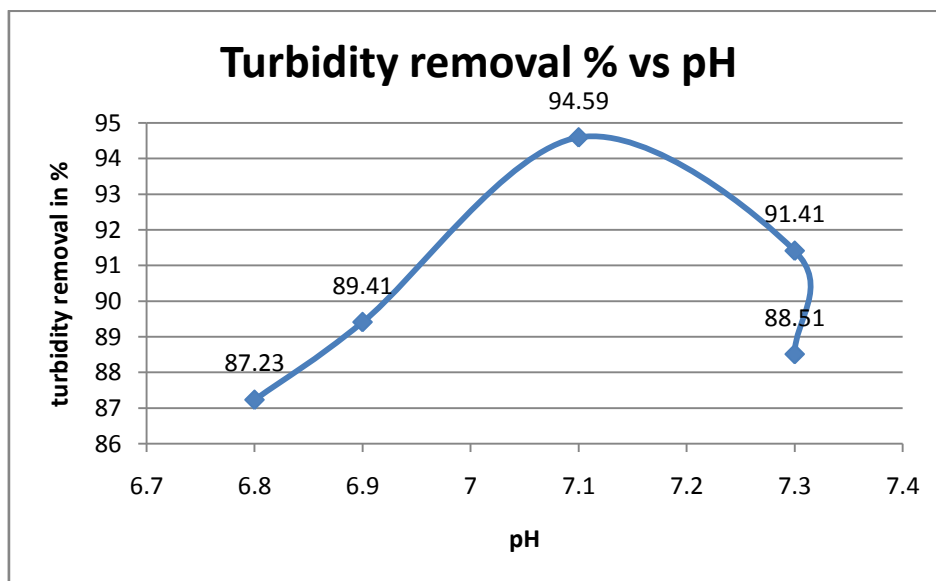


Figure 11: Optimum pH after settling of 60 min using Rice husk ash

The dairy waste water is treated with natural coagulant rice husk and rice husk ash. After process of filtration through a filter paper the characteristics of treated samples were analyzed and it is tabulated in table 3.

**Table 3:** Initial and final values of dairy waste water

Sl.No	Parameters	Units	Initial value	Final value		Desirable limit for irrigation purpose
				Rice husk	Rice husk ash	
1	Color	-	Grey	Pale yellow	Colorless	-
2	pH	-	6.06	7.2	7.1	5.5-9.0
3	Turbidity	NTU	220.2	28.7	11.9	-
4	BOD <sub>3</sub>	mg/l	2510.0	719.0	440.0	500
5	COD	mg/l	4300.0	868.6	628.5	-
6	TSS	mg/l	2520.0	670.0	186.3	200
7	TDS	mg/l	3480.0	876.4	590.0	2100

### 3.4 Efficiency of Rice Husk

To evaluate the efficiency of Rice husk, the optimum dosage and optimum pH can be determined. The obtained treated water has a pale yellow color. Figure 12 shows the treated waste water using Rice husk. Optimum dosage is 1.2 gm/l and optimum pH is 7.2. The reduction in turbidity for the dairy wastewater is 86.96%, reduction in BOD<sub>3</sub> is 71.35%, reduction in COD is 79.80%, reduction in total suspended solids is 73.41%, and reduction in total dissolved solids is 74.8% by the influence of the natural coagulant Rice husk.

**Figure 12:** Treated waste water using Rice husk

### 3.5 Efficiency of Rice Husk Ash

To evaluate the efficiency of Rice husk ash, the optimum dosage and optimum pH can be determined. The obtained treated water is colorless. Figure 13 shows the treated waste water using Rice husk ash. Optimum dosage is 1.2 gm/l and optimum pH is 7.1. The reduction in turbidity for the dairy wastewater is 94.59%, reduction in BOD<sub>3</sub> is 82.47%, reduction in COD is 85.38%, reduction in total suspended solids is 92.60% and reduction in total dissolved solids is 83.04% by the influence of the natural coagulant Rice husk ash.

**Figure 13:** Treated waste water using Rice husk ash

#### 4. Conclusions

The present study deals with the evaluation of treatment efficiency of natural coagulant Rice husk and Rice husk ash, commonly available in nearby market. The various characteristics of untreated dairy wastewater are determined. The color was grey, pH is 6.02, turbidity is 220.2 NTU, BOD<sub>3</sub> is 3400.0mg/l, COD is 4300.0mg/l, total suspended solids is 2520.mg/l total dissolved solids is 3480.0mg/L. The natural coagulant Rice husk and Rice husk ash was selected and its optimum dosage for better efficiency was found as 1.2gm/l. The optimum pH for both coagulants efficiency was also found out.

While using Rice husk as natural coagulant optimum pH is 7.2. The reduction in turbidity for the dairy wastewater is 86.96%, reduction in BOD<sub>3</sub> is 71.35%, reduction in COD is 79.80%, total suspended solids is 73.41%, reduction in total dissolved solids is 74.8% by the influence of the natural coagulant Rice husk. The color of dairy waste water has been changed to pale yellow from grey.

While using Rice husk ash as natural coagulant optimum pH is 7.1. The reduction in turbidity for the dairy wastewater is 94.59%, reduction in BOD<sub>3</sub> is 82.47%, reduction in COD is 85.38%, reduction in total suspended solids is 92.60% and reduction in total dissolved solids is 83.04% by the influence of the natural coagulant Rice husk ash. The color of dairy waste water has been changed from grey to colorless. Hence it was concluded that Rice husk and Rice husk ash can be used as a natural coagulant. The more effective material is Rice husk ash, as all the removal efficiency obtained is higher for this. Water quality parameters after coagulation with above natural coagulant are within the desirable limits for discharging into irrigation land. So the treated dairy waste water by Rice husk ash can be used for irrigational purposes. Both the rice husk and rice husk ash are eco friendly natural coagulants as well as inexpensive to use.

Using Rice husk ash as natural coagulant, treated water can be used for agricultural purpose. If the dairy waste water has been given some more primary treatments prior to coagulation, the water can be safely discharged into inland surface water and marine sea water, and won't affect the aquatic life. More over the treated water can be used for pisciculture.

#### References

- [1]. Anjitha.A , Duithy Goerge “Comparative Study Using Rice Husk and Its Ash as Natural Coagulants in Waste Water Treatment”, International Journal of Scientific & Engineering Research, Volume 7, Issue 4, April-2016 232 ISSN 2229-5518
- [2]. F.V. Adams, A.F. Mulaba-Bafubiandi “Application of rice hull ash for turbidity removal from water”, Physics and Chemistry of the Earth 72–75 (2014) 73–76.
- [3]. M. Senthil Kumar<sup>1</sup>, G. V. T. Gopala Krishna<sup>2</sup> and V. Sivasankar<sup>3</sup> “coagulation performance evaluation of natural and synthetic coagulants in waste water treatment”, ARPN Journal of Engineering and Applied Sciences vol. 10, no. 6, APRIL 2015.
- [4]. I. Nhapi, N Banadda, R Murenzi, C.B Sekomo and U.G Wali “Removal of Heavy Metals from Industrial Wastewater Using Rice Husks” ,The Open Environmental Engineering Journal, 2011, 4, 170-1801874-8295.
- [5]. A.M. Abdelaal “using a natural coagulant for treating wastewater”, Eighth International Water Technology Conference, IWTC8 2004, Alexandria, Egypt.
- [6]. S. Arunthathi and S. Karpagamoorthy “A study on removal of fluoride from water using natural coagulants”, Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115.
- [7]. S.V. Maruti Prasad, B. Srinivasa Rao “Environmental sciences a low cost water treatment by using a natural coagulant”, IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308.
- [8]. Milind R.Gidde, Julie Dutta, Snehal Jadhav “Comparative adsorption studies on Activated Rice Husk and Rice Husk Ash by using Methylene Blue as dye”, International Congress on Environmental Research at bits pilani goa, 08-09.
- [9]. L. Shao, Z. X. Xu, W. Jin, H. L. Yin “Rice Husk as Carbon Source and Biofilm Carrier for Water Denitrification”, Polish J. of Environ. Stud. Vol. 18, No. 4 (2009), 693-699.
- [10]. Ms. S. K. Waghmare “Waste Water Treatment by Adsorption and Coagulation”, International Journal of Engineering Sciences & Research Technology issn: 2277-9655.