The Utilization of Laundry Wastewater as Liquid Fertilizer for Rice Plants

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The Utilization of Laundry Wastewater as Liquid Fertilizer for Rice Plants

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Abstract

The laundry liquid wastewater contains detergents and phosphates which are nutrients for plant which can also cause pollution, explosive growth of aquatic biota, and aquatic ecosystems eutrophication. The great potential of laundry waste requires an efficient and inexpensive waste treatment model to reduce the phosphate content. This study aims to examine the effect of wetlands on laundry wastewater, straw soaking water, and the use of effluent as a liquid fertilizer for rice plants. As well as analyzing the fate of toxic detergents (ABS) in rice grains on a laboratory scale.

The results showed the wetland was able to reduce the pollutants level in laundry wastewater and toxic organic bonds with the BOD, COD, TSS, TDS, Detergent, Phosphate reduction efficiency between 49% - 95%; has met the PERDA DIY no. 7 of 2016 about Quality Standard. The operating conditions that provided the optimum results in this study were the laundry wastewater treatment model and the utilization of effluent as liquid fertilizer for rice plants with straw soaking water neutralization with minimum discharge variations resulting in effluent quality and quantity of harvested products of 75 gr/0.4 m2 and there is a detergent residue content of 24.80 mg/kg; without straw soaking, yields 155 gr/0.4 m2 with detergent residue content of 32.65 mg/kg. Iconic and diagrammatic models of laundry wastewater treatment were obtained based on the quality variable, quantity variable, and the effluent pre-treatment capacity variable thus it can be used as liquid fertilizer for rice plants to describe the behavior of the real system. The factor that has a high influence on system performance, but the dependence between factors is low, namely the effluent flow discharge into the wetland.

Key words: Laundry wastewater, straw, fertilizer, wetland, rice

Abstract

Utilization Of Laundry Waste Effluent As Liquid Fertilizer For Rice Plants . The content of *laundry* liquid waste which contains high phosphate and detergent in addition to being a plant nutrient can also lead to pollution, exploding growth of aquatic biota and eutrophication of aquatic ecosystems. Due to the large potential of *laundry* waste, to reduce the existing phosphate, an appropriate and lowcost waste treatment model is needed. This study aims to examine the effect of wetland on *laundry* waste and straw soaking water and the utilization of the effluent as liquid fertilizer for rice plants. As well as analyzing the fate of detergent toxic substances (ABS) in rice grains on a laboratory scale.

The results showed that the wetland was able to reduce levels of pollutants in *laundry* waste and toxic organic bonds. With the best reduction efficiency of BOD, COD, TSS, TDS, Detergent, Phosphate in the range of 49% - 95%; has fulfilled the Quality Standard of PERDA DIY No.7 of 2016. The operating conditions that provide optimum results in this study are the *laundry* waste treatment model and the utilization of the effluent as liquid fertilizer for rice plants with the neutralization of straw soaking water, the minimum flow variation resulting in the effluent quality and quantity of the harvested product of 75 gr / 0.4 m2 and there is a residual content detergent of 24.80 mg / kg without straw soaking resulted in a yield of 155 g / 0.4 m2 of detergent residue content of 32.65 mg / kg. The iconic and diagrammatic model of *laundry* waste processing is obtained based on the variable quality, variable quantity and variable pre-treatment capacity of effluent so that it can be used as liquid fertilizer for rice plants can describe the real system behavior. Factors that have a high influence on system performance, but the dependence between factors is low, namely the effluent flow rate into the wetland.

Key words: Laundry waste, straw ,fertilizer, wetland, rice

Introduction

In Yogyakarta, Indonesia, the laundry business aside from having the empowerment prospect (job opportunities in the company), also has high economic development (food and economic) opportunities. Laundry waste from the aspect of Natural Resources Management has not been regulated, it doesn't have a good corporate culture towards service users, and it doesn't have an insightful Environmental Resources because it has not been cultured to own a Wastewater Treatment Plant (WTP). The problems seriousness is that laundry waste has not been processed in the Wastewater Treatment Plant (WTP) and is simply dumped into the drainage, aesthetically makes unpleasant view, foamy, and pollutes local waters. The facts on the field show that laundry services are very much attached to the hotel business, hospital, and home industry class. Juridically, home-based businesses are yet to have a Mayor/Regent Regulation, but socio-economically this business provides bright promising prospects, but environmentally the waste is very detrimental towards biota and freshwater ecosystems.

Laundry liquid waste contains several macro and essential nutrients for aquatic biota, which come from detergent constituents. Thus, in terms of quality and quantity the laundry waste discharged into the receiving environment causes blooming algae or the abundance of the aquatic weeds such as water hyacinth, siltation or eutrophication, and reduces the water volume. The social and environmental urgency of the laundry waste creates anxiety as the organic and hydraulic loads of the sewage have changed the quality of the water, the receiving water bodies become frothy and smelly.

Based on information and justification from Manouchehri, Massoumeh dan Ali Kargari, (2017), Schmidt, Stephanie A. dan Changwoo Ahn, (2019), reported the laundry wastewater which utilizing wetlands with subsurface and surface area structures using zeolite, activated carbon and sand media produces environmentally friendly effluents

This study utilized straw soaking water for non-chemical neutralization (UU RI no 18/2008). Referring to Vymazal research, Jan, (2010) by utilizing a wetland horizontal sand filter with an "up flow" stream to reduce the total phosphate concentration, detergent, Total Suspended Solid (TSS), and Total Dissolved Solid (TDS) of laundry wastewater. In addition, referring to the Department of the Environment, (2016) regarding wetlands and agriculture, this study also examines the effect of laundry wastewater treatment results utilizing straw soaking water on laundry wastewater and the growth (vegetative) and productivity (generative) of rice (Oryza Sativa L.) var Ciherang to its grain and analyzed the fate of toxic detergent (ABS) in rice plants.

As well as to get the laundry wastewater treatment model based on quality (chemical content of laundry wastewater), quantity (waste ratio proportion, rice field area), and capacity (addition of rice straw soaking water), and the utilization of effluent as liquid fertilizer for rice plants.

Materials and Methods

The materials needed are home industry laundry wastewater, straw soaking water with acidic pH, wastewater container, anoxic reactor, oxic reactor, wetland reactor composed of gravel, activated charcoal, zeolite and river sand with fast sand filter quality, rice seeds in the form of transplanting, measuring cup, and pH paper.

The procedure for making the straw soaking water. Straw weighing 2 kg is ripened in a closed container with 4 liters of clean water for 2-3 days.The pre-treatment of laundry wastewater with straw soaking water and without straw soaking water neutralization using anoxic and oxic reactors. The effluent then flowed into the Wetlands reactor continuously with the same discharge independent variable, namely 50 cc/minute in the control and treatment groups and debit variation of 100 cc/minute in the treatment group. The observation of the processing efficiency level was carried out after the rice plants began to grow for 20 weeks. The observation process of the reactor effectiveness with periodic laboratory tests. The effectiveness level was measured based on the drop rate in the dependent variable of total phosphate, detergent, TSS and TDS parameters.

The start-up process for rice plants is carried out by transplanting the rice plants (rice plants at the level of leaf emergence and the first-second tiller) with a spacing of 10 cm each. Design and Construction as shown in the pilot plant control and treatment Fig.1

The laundry wastewater samples were taken at the inlet point before treatment and at the outlet point after treatment, samples were taken using the **SNI** 06-1416.1989 method and analyzed according to **SNI** 19-2483-1991;SNI 06-4571-1998;SNI 06-6989-72.2009; SNI 06-6989.3-2019 dan SNI 06-6989.27-2005 parameters.

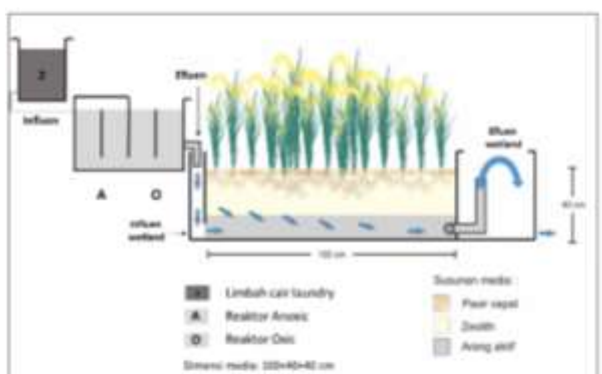

Fig. 1. Wetlands process with anoxic, oxic and without straw soaking.

The plant growth or the vegetative parameters namely plant height and stem/tiller diameter and number of tillers were observed once a week, while the generative parameters such as number of flowers/ panicles, number of grains, and number of fruit were observed after 7 weeks (after the presence of flower stalks) and every once a week, the total length of observation in this study were 20 weeks.

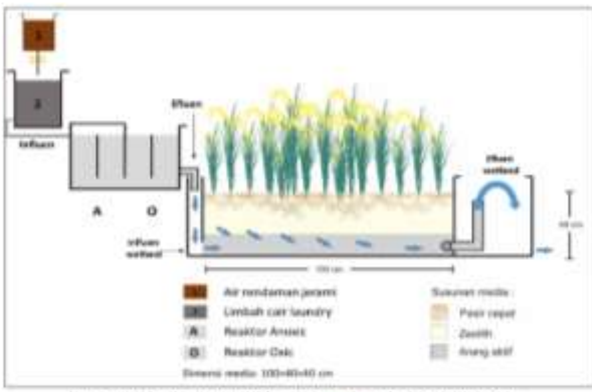

Fig. 2. Wetlands process with anoxic, oxic and with straw soaking.

From the said facts and symptoms, a qualitative descriptive analysis was then carried out as the researcher wanted to describe the situation that would be observed in the field more specifically, transparently, and in depth and quantitatively because the purpose of this study was to explain a situation to be studied with the support of a literature study so that it further strengthened researchers analysis in making a conclusion and the status of water quality (fertility and pollution) was obtained. Based on the analysis results and water quality, a treatment model with an iconic and diagrammatic diagram system was made.

Results and Discussion

From the results of this study, laundry wastewater treatment pilot plant without the utilization of straw soaking water as neutralization it became clear that incomplete biodegradation of tetrapropylene based Alkyl Benzene Sulfonate (hard detergent) branched without addition of organic acid from the straw bath is responsible for the high residual concentration of surface active compounds in the wastewater effluent, because of that, as a result, the nutritional elements are higher than the carbon element causing the existing microbes do not experience stress, resulting in the transformation of detergent/surfactant into abundant poly-P compounds or luxury uptake, which is a building component needed for vegetative and generative growth (Rensink et at 1979.cit Rehm and Reed, 1989).

The observation results of the straw soaking water utilization as neutralization in a pilot plant for processing laundry wastewater effluent as liquid fertilizer for rice plants, gradually affected the effluent characteristic reduction performance and affected the growth and development of rice plants. However, in contrast to the treatment group in which the neutralization of the organic acids from the straw soaking water in anaerobic, anoxic and oxic stabilized laundry wastewater, a transformation of detergent and surfactant nonylphenol into poly-P and chain compounds of toxic and persistent ethoxylate occurred, which are building components that will function on reducing the concentration of free Ca and Mg ions which are found in the mud in unusually high concentrations, also indicate a hitherto unknown pollution problem (Cain, 1981 cit Rehm and Reed, 1989). Another excess of straw soaking water caused luxury up take detergent because of the microorganisms performance and increasing the Total Dissolved Solid as macro and essential nutrients in all pilot plants, this can be seen in growth of the average number of leaves for all treatments in Fig. 3.

illustration, it can be seen in in the processing efficiency percentage graph in Fig.4.

In this study, the effluent utilization as a liquid fertilizer for rice plants provided different stages of growth and it could also be known the contribution of the absorbed nutrients to the yield of different rice grains. The phosphate elements for rice which are classified as major and minor elements (Surajit de Datta, 1981) were more than 2.0 times in control group effluent than in the treatment group, while detergent (ABS) levels were approximately the same between the control group and the treatment group with discharge variations 100 cc/minute. The TDS parameters

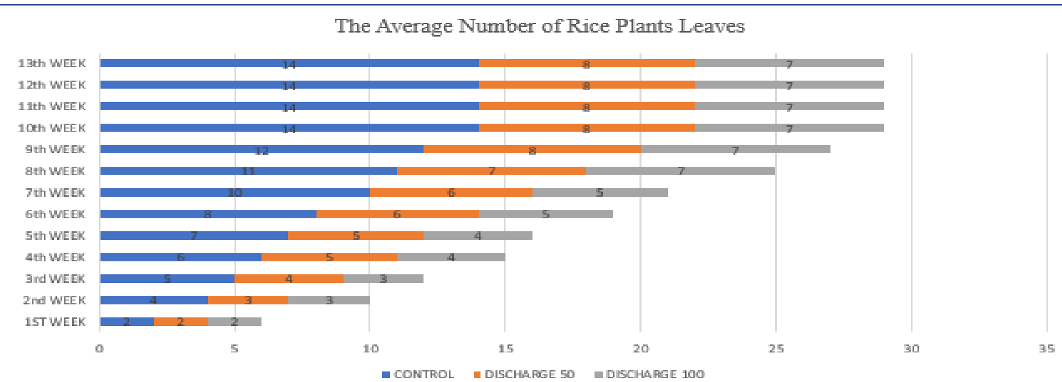

Fig. 3. Graphic of leaves growth in rice plants from 1st week to 13th week

Overall the wetland pilot plant was very effective in reducing the levels of BOD, TDS, Detergent, and phosphate in the control group, respectively 7.3 – 98%; and after straw treatment at a discharge of 50 cc/minute it ranged from 7 – 95% and at a discharge of 100 cc/minute it was around 6 – 89%. And as an

as the representation of metal ions and hardness ions namely the source of carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, potassium and in the form of iron and magnesium traces. Metal ions and hardness ions are expected to be used as nutrients for rice

Fig 4. Removal efficiencies of BOD, COD, TSS, TDS, detergent and phosphate between control and treatment

plants (James W. Patterson, 1995; Surajit de Datta, 1981). The effluent which still contains phosphate parameters after being studied for the application of element P to Wetland results from morphological observations gives different stages of vegetative and generative growth and can also be known about the deficiency and contribution of nutrients absorbed in different rice grain yields.

The diagnosis of the absorbed nutrients contribution gave striking morphological stages of vegetative and generative growth between the control group and between treatments which is presented in the following Fig. 5. illustration below; grain yield in the control group was 155 gr/0.4 m^2 of land area and in the 50 cc/minute discharge variation treatment was 75 gr/0.4 m^2 and in the 100 cc/minute discharge variation treatment it was 62 gr/0.4 m^2.

Overall the wetland pilot plant was very effective in reducing the levels of BOD, TDS, Detergent, and phosphate in the control group, respectively 7.3 – 98%; and after straw treatment at a discharge of 50 cc/minute it ranged from 7 – 95% and at a discharge of 100 cc/minute it was around 6 – 89%.

Thus, although the detergent reduction efficiency in all groups was high, namely 88% and the discharge variation of 50 cc/minute and 100 cc/minute were 95% and 89%, respectively. However, the fate of the toxic substance ABS (detergent) turned out to be translocated to the "grain yield" with measurable quantities as follows. Detergent in the control group was 32.65 mg/kg, the discharge variations of 50 and 100 were 24.80 mg/kg and 41.08 mg/kg, respectively.

Conclusion

The wetland horizontal sand filter treatment for pre-processed laundry waste by

Fig. 5. Flowering and yield of rice plants

utilizing the straw soaking water recycle process using an anoxic reactor and continuous oxic process, is able to improve the quality of laundry wastewater in terms of decreasing the pollutant parameters of total phosphate, detergent, Total Suspension Solid (TSS) and Total Dissolve Solid (TDS). The application of horizontal sand filter wetland treatment for laundry waste by utilizing the straw soaking water recycle process using anoxic and oxic reactors has differences in growth (vegetative) and productivity (generative) as well as translocation / dispersion of the toxic detergent material (ABS) fate in rice plants grain yield. The operation conditions that gives the best/optimum results in this study are the laundry waste treatment model and the utilization of effluent as a liquid fertilizer for rice plants with the straw soaking water neutralization with a discharge variation of 50 cc/minute resulting in the effluent quality and the harvested product quantity being 75 gr/0.4 m^2 and contains a detergent residue of 24.80 mg/kg.

The iconic and diagrammatic models of laundry waste treatment are obtained based on quality variables (chemical content of laundry waste), quantity variables (ratio proportion of the waste and rice land area), and capacity variables (rice straw fermentation liquid addition). Pre-processing effluent thus it can be used as liquid fertilizer for rice plants. It can describe the behavior of the real systems. The factor that has a high influence on system performance, however the dependence between factors is low, namely the effluent flow discharge into the wetland.

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