RESEACH WASTE WATE TREATMENT ABILITY OF HOANG VAN THU JOINT STOCK COMPANY OF PAPER BY USING CONSTRUCTED WETLANDS

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SUMMARY

This report presents the initial results about capacity of using constructed wetlands to treat wastewater of Hoang Van Thu Joint Stock Company of Paper. The research was implemented on three pilot models: Vertical subsurface flow Constructed wetland on cycle shape with H= 35 cm and D = 27.5 cm; 1 layer of gravel support (h_1 = 5cm; d_1 = 4-5 cm; 1 layer of gravel filter (h_2= 30cm; d_2 = 1-2 cm). In Model 1, Cyperus involucratus were planted to treat wastewater following stab tank of wastewater treatment system of Company. Model 2 was similar to Model 1 but it was added domestic wastewater from dormitory of Thai Nguyen University of Technology with ratio: 1/1000. Model 3 was similar to Model 1 and Model 2 but it wasn't planted Cyperus involucratus. These experiments were implemented by pouring 6 litters of wastewater one time with speed of 0.03 L/s. Wastewater in constructed wetlands was static mode, no flow. Density of plant was 14 tree/m^2. These models were operated from 08/04/2015 to 30/04/2015. The optimum hydraulic retention time to treat SS and COD in wastewater of the Company was from 5 to 7 days. SS and COD removals of the Model 1, Model 2 and Model 3 were 75.00%, 77.78%, 75.00% and 76.99%, 75.40%, 36.28% respectively. SS removal capacity was due to filtration of substrates. Plants played a trivial role to remove SS. Cyperus involucratus adapted fast, grew well and had an important role in increasing COD removal ability of wastewater of the Company. No need to add nutrients in the wastewater when planted Cyperus involucratus to treat wastewater of the Company.

Key words: *wastewater treatment, constructed wetlands, treating wastewater of pulp and paper industry, wastewater treatment by constructed wetlands, Hoang Van Thu Joint Stock Company of Paper*

INTRODUCTION

In Vietnam using constructed wetlands to treat wastewater is a new method and being interested. There are some projects researching this technology [2]. Through researching documents, we receive that constructed wetlands can use to treat wastewater of pulp and paper industry in Vietnam to improve the abilities to treat them. Now Hoang Van Thu joint stock Company of paper has capacity to produce 19.000 tons paper/year. The main raw materials are wastepaper and main product is paper packaging cement. The company releases 1131 m^3/day of productionwastewater. It contains many pollutants with high concentration such as COD=690 mg/L,SS = 600 mg/L that exceed emission standards many times. The company is using a wastewater treatment system with capacity of 1300 m^3/day applying aerotanks. Although the system operates stably and achieves emission standards, the high energy and chemical consumptions are difficult problems for maintaining the system. [1] Therefore, it is necessary to research the low cost wastewater treatment and environmentally friendly technologies to treat wastewater of the company. Thus, the researching goal is finding a technology more agreeably and effectively for the company.

OVERVIEW ABOUT USING CONSTRUCTED WETLANDS TO TREAT WASTEWATER OF PULP AND PAPER INDUSTRY IN THE WORLD AND IN VIETNAM

In the world

Constructed wetlands recently have known as the effective and environmently friendly technologies. Many coutries in the world have

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researched and appied the technologies to treat many kinds of waste water inwhich there is the wastewater of pulp and paper industry. Some of the researches are represented below.

In Kenya, 2007, Margaret Akinyi Abiraresearched a model about constructed wetlands to treat wastewater of a pulp and paper company in Kenya[6]. The pilot-scale constructed wetland at Pan African Paper Mills (E.A) Ltd (PANPAPER) in western Kenya consists of 8 subsurface flow cells each of dimentions 3.2m (length) x 1.2m (width) x 0.8m (depth). The latter were initially operated as free water surface flow and later as subsurface flow systems. The subsurface flow cells were planted in pairs with Cyperus immensus, Typha mingensis, Phragmites mauitianus and Cyperus papyrus respectively. All cells were filled with gravel to a depth of 30 cm and had an impermeable barrier that excluded seepage and infiltration. The results indicated that effective treatment of phenol, BOD, SS, N, P were 90%, 30%, 44%, 63%, 100%, 50% respectively. Typha domingensis, Phragmites mauitianus and Cyperus papyrus were fitable to remove N, P.[6]

In Indian, Ashutosh Kumar Choudhary, Satish Kumar and Chhaya Sharmahad researched oganic load removal from paper mill wastewater using green technology and reported the result in WAC 2011. This study evaluated the removal of color and chemical oxygen demand (COD) by hozirontal subsurface flow constructed wetland (HSSF-CW) over period of 15 weeks. The surface area of the treatment system was 5.25 m^2 with dimensions of 3.5 m(length) x 1.5m (width) x 0.28m (depth). Treatment efficiency of the system with hydraulic retention time (HRT) of 4 days was assessed. The COD and color efficiencies for the HSSF-CW system were 73-83% and 88-94% respectively. [4]

These researchers have reported another study to remove of chlorophenolics from pulp and paper mill wastewater through constructed wetland onWater Environment Research (WER) in 1/2013.This study evaluated the treatment efficience of HSSF-CW for removal of AOX (absorbable organic halides) and Chlorophenolics from pulp and paper mill wastewater. The dimentions of HSSF were 3.5m (length) x 1.5m (width) x 0.28m (depth) with surface area of 5.25 m^2. The HSSF-CW was planted with canna indica that had 15 cm average height. HRT was 5.9 days. The average removal of AOX and Chlorophenolics were 89.1% and 67 – 100% respectively.[3]

In Vietnam

Until now, the studies about using constructed wetland to treat wastewater have limitted, especially the wastewater of pulp and paper industry. However, studying documents in the world indicates that constructed wetland can apply to treat wastewater of pulp and paper industry effectively. Therefore, researching to apply the technology to treat wastewater of Hoang Van Thu joint stock Company of paper is feasible.

MATERIALS AND METHODS

Design pilot model

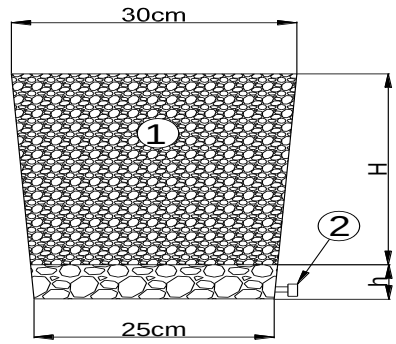

Figure 2: *The chart of pilot-scale model (1. layer of gravel filter; 2. layer of gravel support)*

Using subsurface flow constructed wetland. *Vertical subsurface flow* Constructed wetland on cycle shape with H= 35 cm and D = 27.5 cm; one layer of gravel support in the bottom (h_1 = 5cm; d_1 = 4-5 cm) and one layer of

gravel filter on the top (h_2= 30cm; d_2 = 1-2 cm, U = d_{60}/d_{10}= 1.4, *r*= 0.4). The pilot-scale model is in Figure 2.

Three pilot- scale models were designed in the same structurals and dimensions. In Model 1, Cyperus involucratus were planted to treat wastewater following stab tank of wastewater treatment system of Company. Model 2 was similar to Model 1 but was added domestic wastewater from dormitory of Thai Nguyen University of Technology with ratio: 1/1000. Model 3 was similar to Model 1 and Model 2 but didn't plant Cyperus involucratus.

Operation of the models

The models were placed in Thai Nguyen University of Technology that is far about 15 km from the Company. Cyperus involucratus were planted to adapt for 10 days in model 1 and model 2. After that wastewater was brought from the Company and poured 6 litters into 3 models a time with speed of 0.03 L/s. Wastewater in constructed wetlands was static mode, no flow. Density of plant was 14 tree/m^2.These models were operated from 08/04/2015 to 30/04/2015.

Sampling and measurements

The sampling points were the influence and the efluence of the models from the first day to the fifteenth days after operating. The samples were given as sampling wastewater standards of Vietnam number 5999:1995 and 5993:1995. The method used for the measurements of SS and COD in water sample is Vietnam standard number 4565:1988.

RESULTS AND DISCUSSIONS

SS removal

SS removal is represented in the charts of Figure 3 and Figure 4.

The charts of Figure 3 and Figure 4 indicate that SS removal of all three models are quite hight. By the seventh day, SS from effluents of three models achieve lower the limitation of column B1 and column A of emission standard in Vietnam (50 and 100 mg/L respectively). SS removals of model 1, model 2 and model 3 are 75%, 77.78% and 75% respectively. SS removals between the planted models (model 1 and model 2) and the unplanted model (model 3) are insignificant diference. They indicate that the SS removal capacity is due to filtration of substrates. Plants play a trivial role to remove SS.

COD removal

COD removal is represented in the charts of Figure 5 and Figure 6.

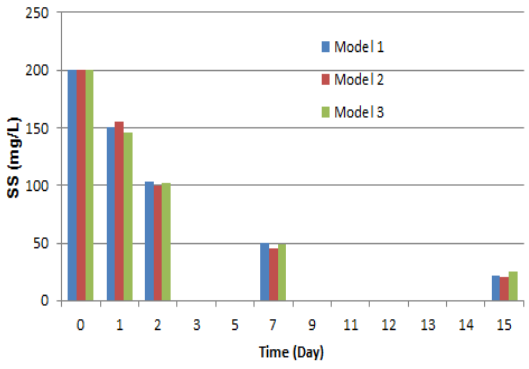

Figure 3: *The SS changes in effluents of three models follows time*

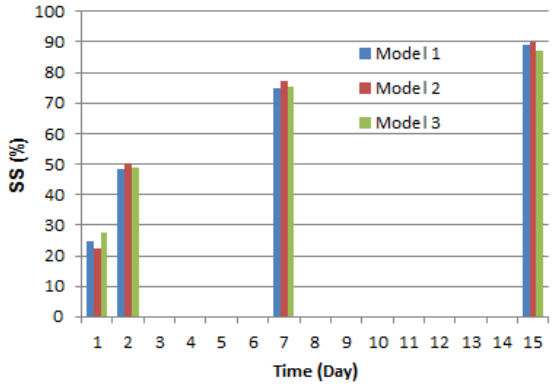

Figure 4: *SS removal of three models follows time*

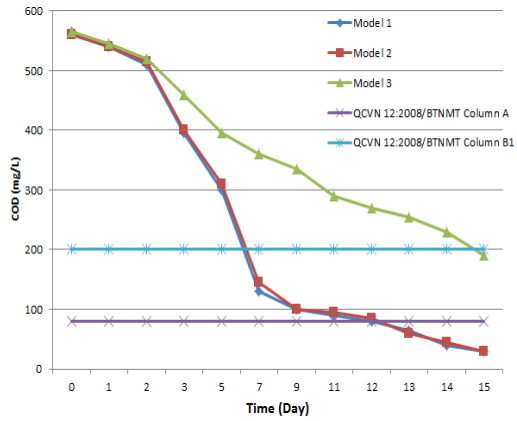

Figure 5: *The COD changes in effluents of three models follows*

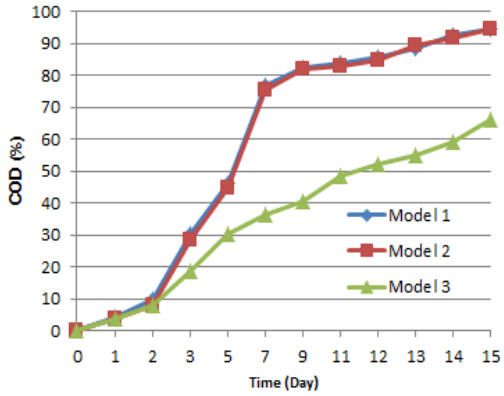

Figure 6: *COD removal of three models follows time*

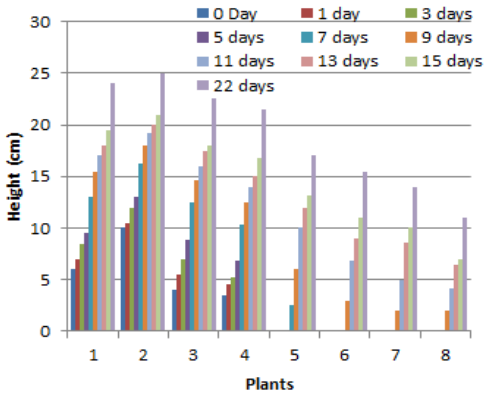

Figure 7: *The chart of Cyperus involucratus growth in the model 1*

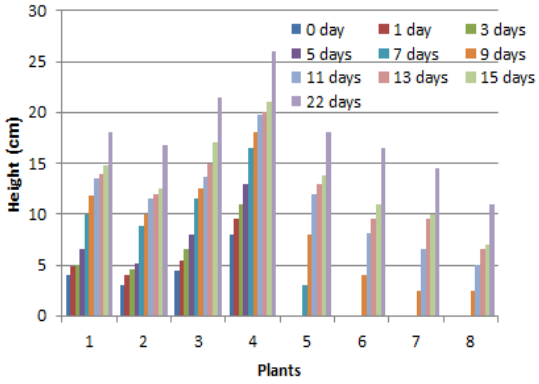

Figure 8: *The chart of Cyperus involucratus growth in the model 2*

The charts of Figure 5 and Figure 6 indicate that COD removal of model 1 and model 2 are similar, so no need to add nutrients into wastewater. COD reduces slowly in the first 2 days and reduces faster from the third day to the seventh day. COD reduces slowlier from the seventh day to the fifteenth day and is 30 mg/L in the fifteenth day. COD removal of model 3 is lower than model 1 and model 2 so much. So, Cyperus involucratus plays an important role in increasing COD removal.

Identify the optimum hydraulic retention time

The time that the SS and COD value of effluence in model 2 decreases lower than the limited values of QCVN 12:2008 column B1 is from the second day to the seventh day and from the fifth day to the seventh day respectively. Therefore, the optimum hydraulic retention time to treat SS and COD in wastewater of the Company will be from 5 to 7 days.

The results consider Cyperus involucratus growth

The Cyperus involucratus growth in the model 1 and model 2 is represented in the Figure 7 and Figure 8.

The charts of Figure 7 and Figure 8 indicate that Cyperus involucratus grow fast in all two models. The plants increased about the height and rose more young plants. During the early five days, the height of plants increased slowly. This period was the time for adapting. The height of plants increased and rose more young plants from the fifth day to the seventh day. From the seventh day to the fifteenth day, the height of plants increases slowly,

while the young plants grew faster. By the twenty second day, the height of all plants increased clearly. Therefore, Cyperus involucratus grew very well in both model 1 and model 2. It was indicated that no need to add nutrients into wastewater of the Company for the growth of Cyperus involucratus.

CONCLUTION

Constructed wetlands recently have known as the effective and environmently friendly technologies to treat wastewater in the world. The technology can treat many kinds of wastewater, specially pulp and paper wastewater. This reseach used construted wetland to treat wastewater of Hoang Van Thu joint stock Company of paper. The results indicated that the optimum hydraulic retention time to treat SS and COD in wastewater of the Company were from 5 to 7 days. SS and COD removals of 3 models were 75.00%, 77.78%, 75.00% and 76.99%, 75.40%, 36.28% respectively. SS removal capacity is due to filtration of substrates. Plants play a trivial role to remove SS. Cyperus involucratus adapt fast and grow well and have an important role in increasing COD removal ability of wastewater of the Company. No need to add nutrients in the wastewater when plant Cyperus involucratus to treat wastewater of the Company.

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TÓM TẮT

KHẢO SÁT KHẢ NĂNG XỬ LÝ NƯỚC THẢI CỦA CÔNG TY CỔ PHẦN GIẤY HOÀNG VĂN THỤ BẰNG CÔNG NGHỆ BÃI LỌC TRỒNG CÂY

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Bài báo trình bày những kết quả nghiên cứu bước đầu về khả năng ứng dụng công nghệ bãi lọc trồng cây trong xử lý nước thải của Công ty cổ phần Giấy Hoàng Văn Thụ. Nghiên cứu được thực hiện trên 3 mô hình thí nghiệm với bãi lọc trồng cây dòng chảy thẳng đứng dạng hình tròn có kích thước: H= 35 cm, d = 27,5 cm; 1 lớp sỏi đỡ (h_1 = 5cm; d_1 = 4-5 cm; 1 lớp sỏi lọc (h_2= 30 cm; d_2 = 1-2 cm). Mô hình 1: xử lý nước thải lấy sau bể điều hòa của Công ty có trồng cây thủy trúc. Mô hình 2: tương tự như mô hình 1 nhưng có bổ sung thêm nước thải sinh hoạt của khu kí túc xá trường Đại học Kỹ thuật Công nghiệp với tỷ lệ 1/1000. Mô hình 3: Xử lý nước thải như mô hình 1 nhưng không trồng cây thủy trúc. Thí nghiệm được tiến hành bằng cách nạp 6 lít nước thải vào 1 lần, tốc độ nạp là 0,03 lít/s. Nước thải trong bãi lọc ở điều kiện tĩnh, không có dòng chảy. Mật độ cây trồng là 14 cây/m^2, mô hình vận hành từ 08/04/2015 đến 30/04/2015. Kết quả nghiên cứu cho thấy thời gian lưu nước tối ưu cho xử lý SS và COD trong nước thải của Công ty nằm trong khoảng từ 5-7 ngày.Hiệu quả xử lý SS và COD ở 3 mô hình tương ứng là 75.00%, 77.78%, 75.00% and 76.99%, 75.40%, 36.28%. Khả năng xử lý SS chủ yếu do quá trình lọc qua lớp vật liệu lọc, thực vật đóng vai trò không đáng kể. Cây thủy trúc thích nghi nhanh và sinh trưởng tốt trong môi trường nước thải của Công tyvà có vai trò quan trọng trong việc làm tăng hiệu quả xử lý COD trong nước thải. Không cần bổ sung chất dinh dưỡng vào nước thảicủa Công ty khi trồng cây thủy trúc.

Từ khóa: *Xử lý nước thải, bãi lọc trồng cây, xử lý nước thải ngành công nghiệp giấy và bột giấy, xử lý nước thải bằng bãi lọc trồng cây, Công ty cổ phần giấy Hoàng Văn Thụ*

Ngày nhận bài:20/6/2015; Ngày phản biện:06/7/2015; Ngày duyệt đăng: 30/7/2015
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