The use of Indrayanti Beach Sand and Coconut Shell Carbon as Absorbents in Selokan Mataram Canal Water Filtration System

Suparno, Subuhul F.R.N, Unang A.A., Widyagusta P., and Lien P.

***Abstract*— An investigation on the use of Indrayanti beach sand and coconut shell carbon as absorbents in water filtration system is reported. This environmentally friendly research is aimed to clean dirty Selokan Mataram canal water which is extremely important for agriculture, fish farm and tourism. Dirty Selokan Mataram canal water was filtered by using Indrayanti beach sand and coconut shell carbon as absorbents in ion exchange columns. The treated water was placed in a transparent container and shot by using a laser beam. The light transmission intensity was then observed by using a luxmeter. The cleanliness of the filtrated water was determined by comparing this intensity to the transmission intensity of the clean tap water to obtain light transmission intensity efficiency. The results show that the efficiency of light transmission intensity decreases with the increase of the volume of dirty water. On the contrary the light transmission efficiency increases with the increase of mass of absorbent. For both cases, the data show that coconut shell carbon absorbs dirty water better compared to the Indrayanti beach sand.**

***Index Term*— absorbent, filtration, Indrayanti beach sand, coconut shell carbon**

I. INTRODUCTION

Selokan Mataram is an irrigation canal approximately 50km long connecting two main rivers in Yogyakarta, Indonesia which are Progo and Opak. The upstream of this canal is a dam on Progo river. The dam is built to collect huge amount of water. It is located at the foothill of Merapi volcano. The water flows through Selokan Mataram canal to the downstream on Opak river. The water is mostly used for rice field and fish farm irrigation. An inspection street was built along the side of the canal as the main access for inspection and maintenance. Many local and international tourists make used of this inspection street to ride bicycle to enjoy panoramic view of Yogyakarta. It takes only an hour bicycle ride by this inspection street from Yogyakarta to the most famous Hindu's temple in Indonesia, Prambanan. Many tourists take advantage of this canal, since there are a lot of other 8^{th} – 9^{th} temples located close to this canal.

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Unfortunately, due to severe erosion Selokan Mataram wate looks very dirty. This can be seen from the color of the wate which is close to light brown. This situation is worsens by th bad habit of the people living along the canal. Many of ther throw their solid domestic and agriculture waste to the cana This causes the water flow through the secondary canal to b blocked in many places. The contamination of the Seloka Mataram water has reached a level which cannot be tolerated Thousands of people working on rice planting and fish farmin suffer from it. Dirty view and bad smell of Selokan Mataram i an obvious threat to tourism industry. An urgent and smart ste has to be made to save Selokan Mataram canal.

On one hand the bad habit of local people throwing thei domestic and agriculture waste must be stop by socializing th law that ban people from throwing anything to the canal. Th government may use local newspaper, radio and television t promote the importance of living in a clean and healthy environment. People's awareness of the importance of keepin Selokan Mataram clean and green has to be raised. They shoul be made understood that disobedience to the environmental la results in severe penalty and punishment.

On the other hand, the erosion of dirt and other contaminan may be overcome by implementing a proper filtration systen Solution of dirt and contaminant in water may be regarded a relatively stable colloid dispersion.[1]-[2] The micrometer siz of colloidal dirt and contaminant may be measured usin Dynamic Light Scattering.[3]-[5] Ions from minerals disperse along with the dirt in the water may cause electrostatic stabilit of the solution.[1]-[2] The charge of dispersed dirt an contaminant may be determined using various techniques.[6] [9] It is the dispersion of dirt and other contaminant particle that also change the color of water from clean to light brown The removal of these dispersed particles from the water ma cause the water to be clean. This may be achieved in two ways The first way is by introducing a coagulating or sedimentatio agent [10] into the water source in the dam. The dirt and othe contaminants will be coagulated. The coagulation of the di and other contaminant is finally followed by sedimentation Cleaner water may flow from the dam through Seloka Mataram canal from the dam to the downstream. However thi can be very expensive since a huge amount of coagulatin agent should be put in the dam now and then. This will be mor

costly during rainy season where the water from the hill bring a lot of dirt due to erosion.

The second way is using water filtration system. This water filtration system is fitted at the sluice gate of the dam and some other location to absorb the dirt in the flowing water. This may result in cleaner water flowing through Selokan Mataram canal. However a cheaper and easier to find absorbent has to be found for long term implementation of water filtration system in Selokan Mataram canal.

An umbrella research has been done by a group of researcher at the Yogyakarta State University lead by Suparno, Ph.D. to find the best absorbent for Selokan Mataram water filtration system. At this stage various kinds of sand and carbon has been investigated. Some of the results of the investigation are reported in this paper.

A relatively simple technique has been implemented in this research. A certain mass of chosen absorbent is put in an ion exchange column and the dirty water is poured on top of the absorbent. The water flows from the top part of the absorbent to the bottom. The dirt in the water may be trapped in the pores and some of them may be adsorbed onto the surface of the absorbent leaving the water to be cleaner. Indrayanti beach sand and coconut shell carbon have been chosen not only due to its porosity, but also its ample availability. The sand may be collected at no cost and the coconut shell may be found easily as waste products. Note that Indrayanti beach is located in the southern part of Yogyakarta province of Indonesia.

The cleanliness of the water is tested by using a home-made light transmission intensity testing unit. This unit consists of a light source, two parallel pinholes, a transparent sample container, another pinhole and a luxmeter which are set in order. Clean tap water was first placed in the sample container and the light transmission intensity is recorded. This water was then replaced by the various treated water and the transmitted intensity are recorded. These recorded transmitted intensities were then compared to that of clean water to obtain light transmission efficiency. The first group of data were taken from 25 samples consisting of five sets of 0.5l, 1.0, 1.5l, 2.0l, and 2.5l of Selokan Mataram (SM) water. Each set of samples was filtered by using 2, 4, 6, 8, and 10 gram of Indrayanti beach sand. The second group of data were taken from the same sets of samples and filtered using coconut shell carbon with the same variables. Each set of data was analyzed and compared to other sets of the same group. Finally the two groups compared to each other.

II. THE PERFORMANCE OF INDRAYANTI BEACH SAND AS ABSORBENT

Figure 1 shows five sets of five data each taken by using Indrayanti beach sand as absorbent. The first set of sample consisting of 0.5l, 1.0l, 1.5l, 2.0l, and 2.5l of Selokan Mataram water (SM water) was filtered using 2 grams of sand each. The second set of 0.5l, 1.0l, 1.5l, 2.0l, and 2.5l of SM water wa filtered using 4 grams of sand each. The same steps were don using 6, 8, and 10 grams of sand. The data show that the ligh transmission efficiencies tend to increase with the increase o the mass of sand. For 2.5liters of SM water the ligh transmission efficiency increases from 83% to 88%. This mean that the increase of the mass of sand results in the cleaner wate This may be easily understood, since the increase of the mass o sand means the increase of the number of pores to trap mor dirt and contaminant. However it should be noted that the times increase of the mass of sand results in only 5 percent increase in light transmission efficiency.

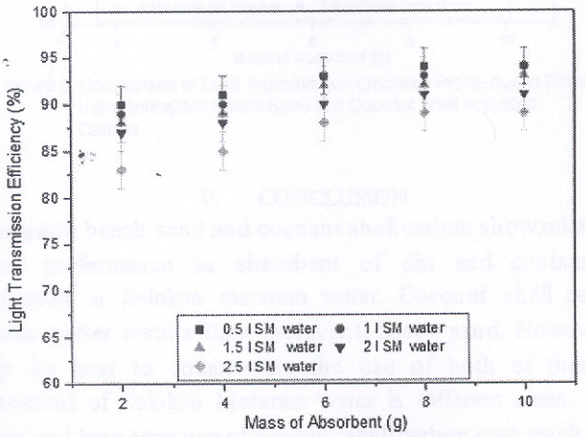

Figure 1. Light Transmisson Efficiency Profile due to Filtration Using Indrayanti Beach Sand

For samples which were filtered by using 2 grams of sand, th increase of volume of SM water reduces of light transmissio efficiency from 90% to 83%. This means that the total capacit of the pores to trap the dirt and contaminant reduces with th increase of the volume of SM water.

III. THE PERFORMANCE OF COCONUT SHELL CARBON

Coconut shell carbon has been used in various applications no only for environmental reasons [11]-[14], but also for medic health purpose.[15]-[17] It has also been used as sedimentatio agent in water purification system.[10] In some part o Indonesia traditionally carbon is used to absorb the bad sma coming out of the dead body.

Figure 2 presents comparable data to those of Figure 1 excep data in Figure 2 were taken using coconut shell carbon a absorbent. The data show that the light transmission efficiencie tend to increase with the increase of the mass of coconut she carbon. For 2.5liters of SM water the light transmissio efficiency increases from 89% to 93%. This means that th increase of the mass of carbon causes the increase in th cleanliness of the water. This is quite logical since the increas

of the amount of carbon means the increase of the number of pores to trap more dirt and contaminant. However it should be underlined that the 5 times increase of the mass of carbon results in only 4 percents increase in light transmission efficiency.

For samples which were filtered by using 2 grams of carbon, the increase of volume of SM water reduces of light transmission efficiency from 95% to 89%. This means that more dirt and contaminant left in the SM water with the increase in the volume of SM water.

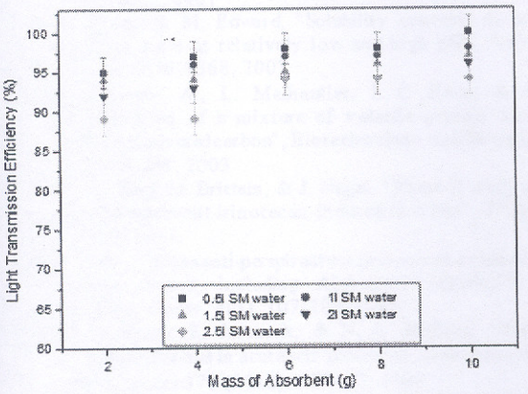

Figure 2. Light Transmission Efficiency Profile due to Filtration Using Coconut Shell Activated Carbon

IV. COMPARISON BETWEEN INDRAYANTI BEACH SAND AND COCONUT SHELL CARBON

Figure 3 presents the comparison of light transmission efficiency through SM water that has been filtered using Indrayanti beach sand and coconut shell carbon. The empty bullets represent the collected data by using coconut shell carbon as absorbent and the filled bullets represent those of using Indrayanti beach sand. Figure 3 shows that both groups of data show the same trend. The light transmission efficiency increases with the increase of the mass of sand or carbon. This means that the cleanliness of the water increase with the increase of the mass of absorbent. However, almost all data points collected using carbon are higher compared to those of using sand. This means that coconut shell carbon has been functioning better as absorbent of Selokan Mataram water compared to Indrayanti beach sand.

From physicist point of view it is coconut shell carbon that should used to filter the dirty Selokan Mataram water. People should be encourage to recycle coconut shell waste products to become coconut shell carbon. However mass and long term used of carbon more costly compared to sand. A compromise between these two absorbents may be the best way to choose. In areas having excessive amount of coconut shell waste products, the coconut shell carbon should be used as absorbent. Whereas in areas having limited amount of coconut shell waste products, the Indrayanti beach sand should be used to clean Selokan Mataram dirty water.

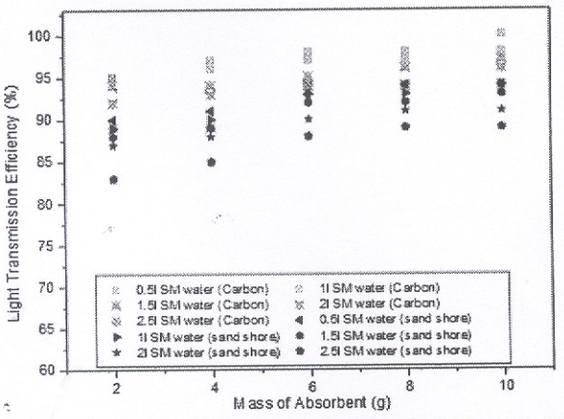

Figure 3. Comparison of Light Transmission Efficiency Profile due to Filtration Using Indrayanti Beach Sand and Coconut Shell Activated Carbon

V. CONCLUSION

Indrayanti beach sand and coconut shell carbon show relatively good performance as absorbent of dirt and contaminan dispersed in Selokan mataram water. Coconut shell carbo shows better results than Indrayanti beach sand. However, may be best to compromise the use of both of them a absorbent of Selokan Mataram water in different areas, sinc mass and long term use of coconut shell carbon cost much mor expensive than Indrayanti beach sand.

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LAPORAN PENELITIAN

PENGEMBANGAN ILMU

PENGEMBANGAN SISTEM FILTRASI UNTUK PENJERNIHAN AIR SELOKAN MATARAM DENGAN MEMANFAATKAN PASIR ALAM DAN KARBON AKTIF

Oleh:

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JURUSAN PENDIDIKAN FISIKA
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
UNIVERSITAS NEGERI YOGYAKARTA

2012

DEPARTEMEN PENDIDIKAN NASIONAL
UNIVERSITAS NEGERI YOGYAKARTA
FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM
Karangmalang, Yogyakarta Telp. 586168 psw 365

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4. Mahasiswa yang terlibat : 4 orang
5. Lama Penelitian : 6 bulan
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Abstrak

Penelitian pendahuluan telah dilakukan untuk menentukan bahan-bahan yang sesuai untuk dipergunakan sebagai absorbent kotoran yang terlarut dalam air selokan Mataram. Kejernihan air selokan sangat penting untuk petanian, perikanan dan industri pariwisata yang memanfaatkan jalan inspeksi selokan Mataram sebagai jalur wisata.

Proses penjernihan dilakukan dengan filtrasi air selokan Mataram di dalam kolom penukar ion dengan menggunakan 4 jenis karbon dan 4 jenis pasir. Kejernihan air yang telah diberi perlakuan dilakukan dengan mengukur transmisi cahaya di dalam air tersebut di dalam bak penguji. Untuk masing-masing absorbent profil efisiensi transmisi cahaya disajikan dalam bentuk grafik sebagai fungsi masa absorbent.

Hasil penelitian menunjukkan bahwa jenis karbon berpengaruh terhadap efisiensi penyerapan kotoran dengan efisiensi penyerapan tertinggi yang diwakili oleh efisiensi transmisi cahaya ditunjukkan oleh karbon aktif tempurung kelapa (88-99)%, diikuti oleh kayu Asam (68-91)%, Akasia (64-92)% dan Sonokeling (29-82)%. Hal yang sama ditunjukkan oleh pasir dengan efisiensi tertinggi ditunjukkan oleh pasir pantai Indrayanti (83-94)%, diikuti oleh pasir kali Putih (68-88)%, pasir kali Progo (65-86)% dan pasir pantai Baron (28-77)%. Hasil penelitian juga menunjukkan bahwa peningkatan absorbent (karbon atau pasir) cenderung meningkatkan efisiensi penyerapannya terhadap kotoran yang terlarut di dalam air selokan Mataram.

Daftar isi

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
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4. Status Penelitian : Penelitian Kelompok/Mandiri *)
5. Judul Penelitian : Pengembangan sistim filtrasi untuk penjernihan air sekolah menggunakan memanfaatkan pasir dan karbon aktif
6. Pelaksanaan : Tanggal, 30 Nov. 2012 Pukul : 15.00 -
7. Tempat :
8. Dipimpin Oleh : Ketua : .....
   Sekretaris : .....
9. Peserta : a. Konsultan ..... orang
   b. Nara Sumber ..... orang
   c. BPP ..... orang
   d. Peserta lain ..... orang
   Jumlah ..... orang
10. Hasil Seminar :
    Setelah mempertimbangkan penyajian, penjelasan, argumentasi, sistematika, dan tata tulis; seminar berkesimpulan :
    Proposal penelitian tersebut di atas :
    a. Diterima, tanpa revisi/pembenahan
    b. Diterima, dengan revisi/pembenahan
    c. Dibenahi, untuk diseminarkan ulang.
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