Valuation of Industrial Water Quality on Coconut Composite as Filter Media

Sazali Said [1*] Iqbal Adnan[1] Norisha Shabri[1] Ahmad Syafiq[1] Shafiq Azman[1]

Shahrizan Yusoff[1]

[1]*Department of Engineering Technology, section Manufacturing, University of Kuala Lumpur, Malaysia*
*Corresponding author. Email: msazali@unikl.edu.my

ABSTRACT

Deterioration of surface water quality is the effect of anthropogenic activities in research areas due to rapid industrialization. The study was conducted to determine the spatial variation of the water quality of the industrial water effluent following the Malaysian National Quality Standard (MNQS). This research highlights the use of coconut activated carbon (CAC) as a raw material with epoxy resin and a hardener to form coconut composite (CC). The pH, total dissolved solids (TDS) and electrical conductivity (EC) parameters of the MNQS were collected before and after filtration by filter media to meet the objectives. The Taguchi method design parameters were used to minimise variance before optimising design for the output parameters to meet mean target values. Then, the study continued with the confirmatory tests to ensure that the results of the experiment were valid and completed. As for pH test experiment, the optimum parameters were for CAC 13.4 and epoxy resin, hardener 2.7. As for TDS and EC test experiment, the optimum parameters were for CAC 14.1 and epoxy resin, hardener 2.7. All data are valid as an error of less than five per cent based on confirmation testing.

Keywords: Coconut composite, coconut activated carbon, water quality, taguchi method, filter media

1. INTRODUCTION

In recent years, there has been an increasing interest in water quality that is typically a state of water's biological, physical, and chemical properties in combination with anticipated usage and a set of standards. Besides, surface waters are vulnerable and powerless due to pollution resulting from natural processes such as precipitation, disintegration, weathering of crustal material, sedimentation, erosion and anthropogenic exercises including industrial, urban, horticultural and agricultural activities. Several studies have revealed that water quality is a primary ecological concern worldwide. On the other hand, pollution is the primary cause of change in a river's water quality which is characterised as an environmental contamination by nature or human exercises that can damage the ecosystem as a whole. Miller WW (1986) presented a comprehensive review of water pollution as any chemical or physical surface water changes that can affect living life forms or make water unsafe for particular uses. Assessing the water quality status of any river water is essential to measure the pollution from its primary root, which contaminates various constituents into the river. There are two major categories which are point and non-point emission sources and are defined by their chemical, physical, and biological attributes.

Today's water quality problem is particularly a concern to all water bodies around the world as a whole as their vast drainage basin is vulnerable to water contamination due to the rate of urban, industrial wastewater and runoff from agricultural land to the river. Kamarudin AF (2015) found

out that it strongly determines the water quality in any region by both natural processes. However, to evaluate and monitor the quality of water in any river system, researchers used the MNQS for a full assessment of the biological, physical and chemical characteristics of any surface water studies. The use of MNQS is referred as a numerical representation to convert a comprehensive collection of water quality data into a single index number, which indicates the level of water quality. Based on study by Zhang (2009), the main danger of water contamination is not only the case of humans but the complete environment of both aquatic and terrestrial, social stability and economic growth such as areas where successful fishing takes place.

Several low-cost adsorbent from agricultural wastes or by-products have been used in recent years for adsorption processes, such as water filter media. These adsorbents are very economical, environmentally friendly, renewable, cheaper with excellent ability to remove the dye, and abundantly available. Coconut has been cultivated along the Peninsular Malaysia coastline. Hence, large quantities of solid wastes are produced annually in the form of fibres and shells. It is highly recommended that these wastes can be used as an activated carbon precursor to moderate the issue of solid waste disposal as well as generate local economy. This is supported by a study by S.A Haji Azaman (2018) which reveals that coconut activated capabilities are considered adsorbent low cost for industrial wastewater pollution. Also, coconut composite manufacturing was conducted to demonstrate the reusability of the water filter media layer on adsorbent mechanism.

The composites consist of two or more materials that are physically or mechanically distinguishable. Due to their versatile diversified nature and renewability, natural fibres-

reinforced polymer composites are gaining paramount importance day by day in the field of composite research and industry. They possess a range of potential benefits, particularly in terms of their performance for the environment. They do not causes net emissions of carbon dioxide to the environment when natural fibre-composite waste is incinerated, The matrix size, number and properties of the interaction between filler and fibre- matrix mainly affect the properties of polymer composites reinforced by lingo cellulosic natural fibre. The fibre- matrix interface properties vary from the bulk matrix properties. The interface also transfers stress between fibre and matrix, and controls the composites properties and durability. Natural fibres derived from lingo cellulose contain strongly polarised groups of hydroxyls. These hydroxyl groups are responsible for the water adsorption and the resultant product deformation. As a consequence, the natural hydrophilic fibres are inherently incompatible with hydrophobic polymer. Chemical treatment of natural fibre is the way to improve performance.

2. COCONUT COMPOSITE AS FILTER MEDIA

2.1 Fabrication of Coconut Composite

Tan Meng Keong Sdn Bhd located in Perak, Malaysia supplies the powdered coconut activated carbon as a raw material for fabrication of coconut composite. The CAC has been branded as TMKCARBON triggered by steam air agent. The initial summary was given by the company stating that the activated carbon has iodine adsorption of at least 950 to 1300 mg/g, an apparent density of 0.23 to 0.43 g/ml, a maximum ash and moisture content of ten per cent more critical, and ninety per cent of the powder is small. The AB glue resin is epoxy resin that will be used in this fabrication. This resin is the hard form that will be excellent for the finished fabricate. This resin cure time depends on the temperature around 16 to 24 hours. This is also a transparent coloured resin, and 3:1 (epoxy resin: hardener) is the manual stating the correct ratio for this resin. For fabricate, the parameter of this fabrication was fifty-six per cent of coconut activated carbon and remaining for epoxy resin, hardener. The weight of the CAC and epoxy resin, hardener were measured using the analytical measurement. The mixture between epoxy resin and hardener was stirred for 5 minutes at 33: 11 to avoid a bubble that could spoil the mixture. Once the measurement of the CAC and epoxy resin, hardener was done, both substances were mixed in the beaker. The composite was the stirred for 10 minutes so that the composite blended properly. The mixture was poured into the mould, after 10 minutes of stirring the composite. The frame was made by cutting off the lower parts of a plastic bottle which acting as a template for the composite. The reason of using a plastic bottle as a template composite

was to ensure that the composite product dimension would be same as the water filter size of the chemical adsorption experiment conducted using the same size of plastic bottle. The mixture was then left for 24 hours. After 24 hours of given cure time, the composite was remoulded from the mould and became the end product of the pre-model fabrication.

2.2 Manufacture of Water Filter Media

A manufacture model for the water filter was built in this present analysis. Therefore, in the filtration process, the purpose of the present study was to examine industrial wastewater by using coconut composite as an adsorbent mechanism. Quality of water was evaluated after filtration, where the effectiveness of each adsorbent was established and the filtration efficiency was regulated. A simple bottle-shaped filter was built and invented in the proposed study by using an empty bottle, as shown in Figure 1 with the following dimension.
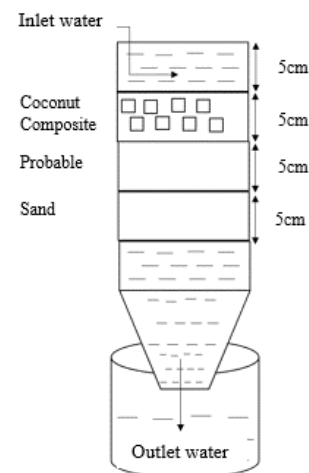

Figure 1 The water filter with dimension

The industrial wastewater was passed through the inlet water filter platform on top of the model's proposed configuration. Different adsorption media of 20 cm, 5 cm each thickness was mounted within filtration. The specific coconut composite numeral layer as an adsorbent was evaluated. After filtration, the filtered water was collected through a tap into a beaker at the bottom of the filter, and the filter water was checked by water quality testing for the various water quality parameters like pH, EC and TDS.

3. RESULTS AND DISCUSSION

3.1. Related Work

Based on Table 1, nine different weight samples of CAC and epoxy resin, hardener were shown. Also, the different layers were noticeable in each sample. Therefore, based on Table 2 and Figure 2, the reading on change in pH value is indicated. This change was due to the MNQS, which is between pH 6.5 and pH 8.5. These are one of the most critical parameters in determining industrial wastewater in acidic or alkaline conditions. The difference of the reading is between 0.1 and 0.75. The difference between the nine samples is most noticeable in Sample 1, which is 0.75. Sample 1 contains CAC (11.7g) and epoxy resin, hardener (2.7g) on 4 layers of coconut composite on water filter media.

Table 1 The fabrication coconut composite

No.of sample	Activated Carbon (g)	Epoxy Resin and Hardener (g)	Layer
1	11.7	2.7	4
2	11.7	3	5
3	11.7	3.33	6
4	12.1	2.7	5
5	12.1	3	6
6	12.1	3.33	4
7	12.4	2.7	6
8	12.4	3	4
9	12.4	3.33	5

Table 2 The value of pH before and after filter

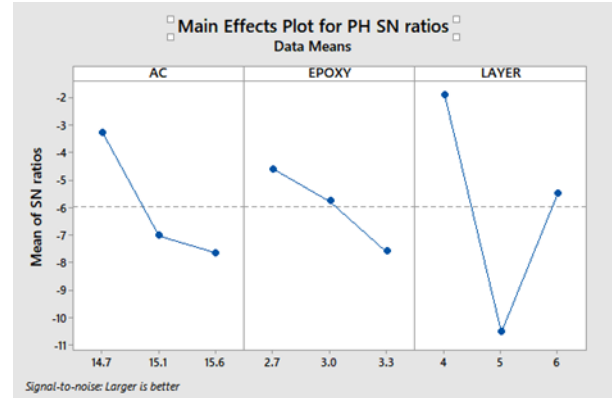| No.of sample	Before (pH)	After (pH)	Different (pH)
1	8.86	8.11	0.75
2	7.72	7.82	0.10
3	8.22	7.80	0.42
4	7.38	7.28	0.10
5	6.71	7.04	0.33
6	6.78	7.10	0.32
7	7.20	7.30	0.10
8	6.88	7.26	0.38
9	6.89	7.18	0.29

Figure 2 Graph for value of pH before and after filter

Table 3 and Figure 3 show the reading of the EC in µS/cm before and after filtration using coconut composite as water filter media. This reading of the value was obtained using a water quality tester with critical parameters in MNWQ. The adjustment in reading for this value was due to the norm set below 1000 µS/cm. EC is a measure of the ability of the water to pass electrical flow. This capacity is directly associated with ion concentration in water. These conductive ions are derived from dissolved salts and inorganic materials such as alkalis, chlorides, sulphides and compounds from carbonates. In Figure 3, the readings of EC changed between 78 µS/cm and 190 µS/cm, depending on the industrial wastewater taken from it. Besides, the ninth-largest shift of 190 µS/cm was CAC (12.4g) and epoxy resin, hardener (3.0 g) on five layer of coconut composite on water filter media.

Table 3 The value of EC before and after filter

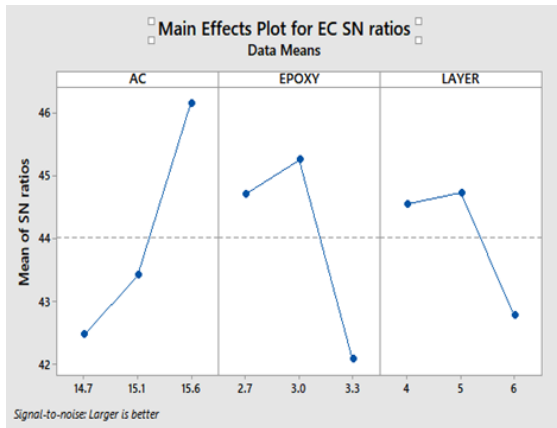| No.of sample	Before (µS/cm)	After (µS/cm)	Different (µS/cm)
1	176	245	78
2	166	266	100
3	120	210	90
4	114	228	114
5	120	238	118
6	106	230	124
7	126	223	97
8	108	244	136
9	110	300	190

Figure 3 Graph for value of EC using Taguchi Method

Table 4 and Figure 4 show the reading of TDS values in mg/l units before and after filtrate coconut composite as water filter media. In addition, the reading value of TDS for MNWQ is below 500 mg/l. TDS stands for total dissolved solids that dissolved substance concentration in the water. TDS consists of inorganic salts and small amount of organic matter. Common inorganic salts found in water include calcium, magnesium, potassium and sodium all of which are ions with positive charges. Carbonates, nitrates, bicarbonates, chlorides and sulfates are negatively charged ions. Thus, on water filter media samples on coconut composite can be distinguished between before and after filtration process. The difference after a filter is more critical on industrial wastewater than before screen is the effect of adsorption mechanism efficiency on coconut composite.

Table 4 The value of TDS before and after filter

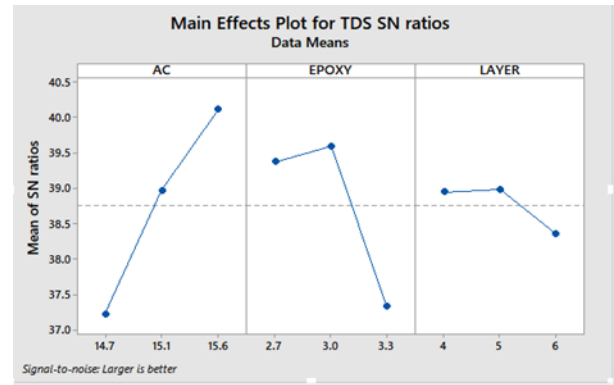| No. of sample	Before (mg/l)	After (mg/l)	Different (mg/l)
1	92	124	32
2	83	123	40
3	59	101	42
4	56	105	49
5	48	117	69
6	63	123	60
7	72	110	38
8	54	143	89
9	55	138	83

Figure 4 Graph for value of TDS using Taguchi Method

4. CONCLUSION

The following conclusions can be drawn from the present study coconut composite as water filter media. The results of this study indicate the optimum parameter of pH value, 14.7g of CAC were mixed with 2.7g of epoxy resin, hardener and 4 layers of blocks. One of the more significant finding to emerge from this study is that the optimum parameter EC and TDS value, 15.6g of CAC were mixed with 3.0g of epoxy resin, hardener and usage of 5 layers of coconut composites. Experimentation with Taguchi's method is reliable and makes the experiment clearer to set up and be analysed from results water quality testing for coconut composite as water filter media. In this manufacture, the fabrication of the coconut composite, the filtration experiment and Taguchi method analysis were achieved.

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