The development of ceramic fiber via sacrificial method

M.S. Sharmiwati*, Z. Azmiza, S. Fazidah, M.H. Nuraida, H. Roshanizah

Universiti Kuala Lumpur Malaysian Spanish Institute, Kulim Hi-Tech Park, 09000 Kulim, Kedah, Malaysia.

*Corresponding e-mail: sharmiwati@unikl.edu.my

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ABSTRACT – Ceramic fibre for water filter cartridge was designed to create alternative way to replace typical water filter with the aim to produce clear water. Ceramic fibre in this study was produced through sacrificial template method. This paper also studies the linear shrinkage, density and porosity of 50wt% solid loading of porcelain and distilled water with different amount solid loading. Banana pseudostem was immersed in ceramic slurry with solid loading ranging from 300g to 500g.

1. INTRODUCTION

In this research ceramic fibre from banana pseudostem was used as template in sacrificial method. This ceramic fibre is designed to remove suspended matter from muddy water using sedimentation and filtration in order to produce clear water.

In sacrificial method [1], template of banana pseudostem will immerse in ceramic slurry followed by drying and sintering process. Different weight percentage of banana pseudostem was used to produce different pore sizes of ceramic. In previous study [1-3], sacrificial method was used because of its properties are high temperature stability, high resistance of chemical and high hardness. Ceramic fibre is also known as porous ceramic and open cell ceramic. Ceramic fibre possessed great potential properties including low density and low thermal conductivity.

In previous study [2], ceramic sponge from polyurethane (PU) was used as water filter cartridge. Different range of pore per inch (ppi) of PU sponge was used as template in sacrificial method. The ceramic sponge were arrange according to different pore sizes in water filter cartridge in order to replace the typical water filter.

The objective of this study is to develop an alternative way in producing ceramic fibre using sacrificial method by producing ceramic fibre using banana pseudostem with different amount of fibre. The ceramic fibre is then replacing the typical filter cartridge.

One of the most significant current discussions in environmental concern is usage of biodegradable material. Banana pseudostem is one element in ceramic fibre which is biodegradable material. Usage of organic material can increase awareness among people about environmental problem.

2. METHODOLOGY

This chapter provides information about sacrificial method and equipment used in the experiment.

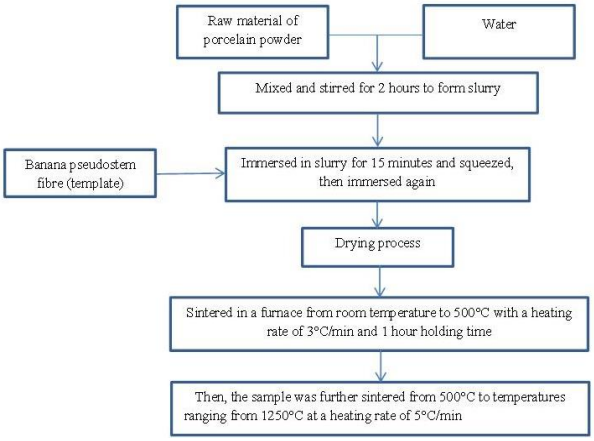

Figure 1 Method to prepare ceramic fibre via sacrificial method.

From previous research [3], the procedure used in the synthesis of ceramic foam replication method where polymer sponge that used are different size such as 20 ppi, 50 ppi, 80 ppi and 100 ppi and cut the sponge into pieces of about 30 – 60 mm. The preparation of ceramic slip, the ceramic powder should be mixed with the water according the accurate ratio. The coating was performed by immersing the sponge pieces in the slurry, squeezing them, and passing them through rollers preset at 80% impression to expel the excess slip. The solid content (based on the mixtures) was varied to produce ceramic slurries with densities of 1.1845, 1.2798, 1.3567, 1.54332, 1.6543 and 1.7234 g/cm3, in a distilled water medium. The green body was dried 24 hours at room temperature and heated at 1 at 1°C/min to 700°C, and then a further at 10°C/min to the final temperature (1800°C), which was held for 500 min to achieve sintering of the ceramic. The properties of the ceramic foam produced were characterized according to ASTMC 271-94 and the porosity was characterized using the Archimedes method. The density of ceramic slurry will increase when porosity of slurry decrease. The quality of ceramic foam is strongly influenced by the density of the slurry, as this reflects the degree of porosity [4] .

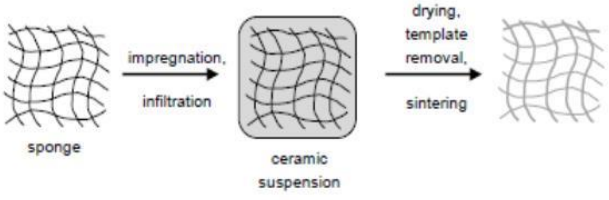

Figure 2 Schematic illustration of sacrificial method.

3. RESULTS AND DISCUSSION

This chapter deliberates about the relationship between linear shrinkage, porosity and density of sintered ceramic fibre.

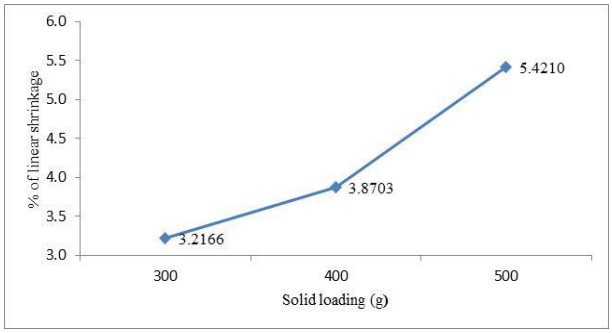

Figure 3 Linear shrinkage (mm) changes with solid loading (g).

During sintering process, the ceramic fibre of banana pseudostem will shrink and became smaller. The measurement of ceramic fibre will reduced through this process. This happen because the ceramic take place of banana pseudostem which have been removed as the template. The percentage of 50wt% solid loading of porcelain and distilled water will affect the linear shrinkage of ceramic fiber [5].

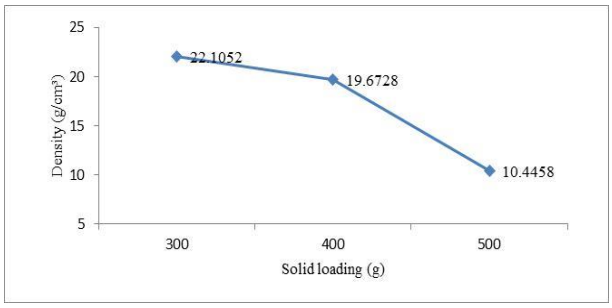

Figure 4 Density (g/cm³) changes with solid loading (g).

The density of ceramic fibre decrease when the solid loading increases. 50wt% solid loading of porcelain and distilled water for different amount of solid loading will affect the density of ceramic fibre. The banana pseudostem is easy to coat with low viscosity of ceramic slurry. This is due to the sintered ceramic foam which was less percentage of porosity had more closed pore or more solid structure. This implied that higher content of solid loading, the density increased.

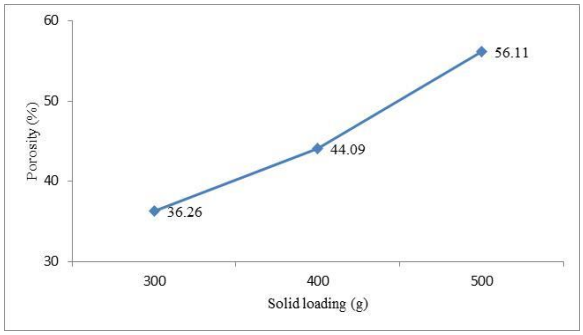

Figure 5 Porosity (%) changes with solid loading (g).

The percentage of porosity plotted in figure 6 clearly show amount of porosity increase with changes of 50wt% solid loading of porcelain and distilled water for different amount of solid loading. It is clearly stated that density of ceramic fibre decrease when porosity increase. The shrinkage during sintering process also affects the pore size of ceramic foam. This implied that higher content of solid loading, the porosity decreased. Porosity decreased means that the sintered ceramic foam had more open pores and bigger pore sizes.

4. CONCLUSIONS

The present study was designed to develop the potentials of ceramic fibre from banana pseudostem to filtrate muddy water to get clean water via replication method. From this study, the ceramic fibre able to withstand at 1250˚C as optimum temperature for sintering process. This study indicates that the ceramic fibre able to produce clear water within acceptable ranging which is 60mg/L in TDS analysis and turbidity is 22.9NTU. More research is required to identify the lifetime of the ceramic fibre for water filter cartridge and to produce clean water from ceramic fibre water.

5. REFERENCES

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