Preparation Of Low-cost Porous Mullite Balls From Kaolin And Alumina Using Naphthalene As Pore-former

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Introduction

- Support for the heterogeneous catalyst attracts the great interest in many industrial applications like biomass conversion, ammonia synthesis, renewable fuels, selective oxidation, renewable chemicals, etc.
- It should have sufficient mechanical strength, high thermal and chemical stability.
- In this work, binary system of Al_2O_3-SiO_2 is taken into consideration to form porous spherical mullite balls having high thermal and chemical stability with adequate mechanical strength to achieve high quality of support for catalysts.
- Kaolin is abundantly present in the nature but it shows deficiency of alumina to form stoichiometry mullite structure.
- Therefore, required amount of alumina (Al_2O_3) is added from outside to maintain the stoichiometry ratio between Al_2O_3 and SiO_2 to form stable mullite system.

Methodology

Kaolinite + Alumina + Naphthalene

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Ball milling for 1hr

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Spherical Balls (Prepared Manually)

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Dried at room temperature for 12hrs and then 60°C for 2hrs

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Sintered at 1600°C for 2hrs

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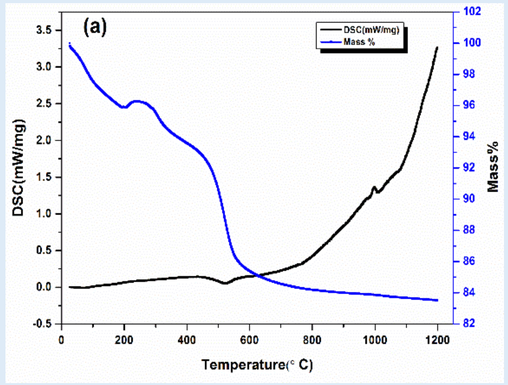
Porous Mullite balls

Kaolin (gm)	Alumina (gm)	Naphthalene (gm)	Wt. % of Naphthalene (Pore-former)
3.1306	2.869	0	0%
2.9742	2.7258	0.3	5%
2.8176	2.5823	0.6	10%
2.6611	2.4388	0.9	15%

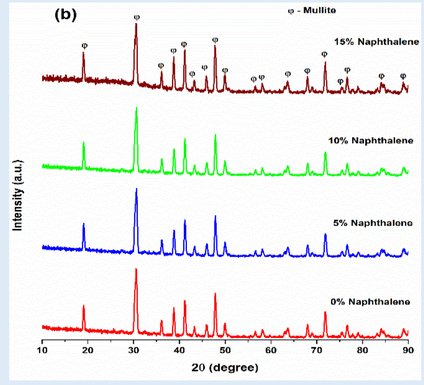
Table 1. Batch calculation for each spherical ball of 6gm

Results & Discussion

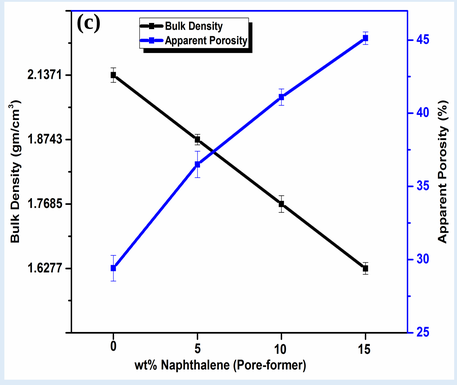
Thermal Analysis, Phase analysis, Apparent porosity and bulk density



- DSC-TG curve of the batch without any pore-former i.e., naphthalene

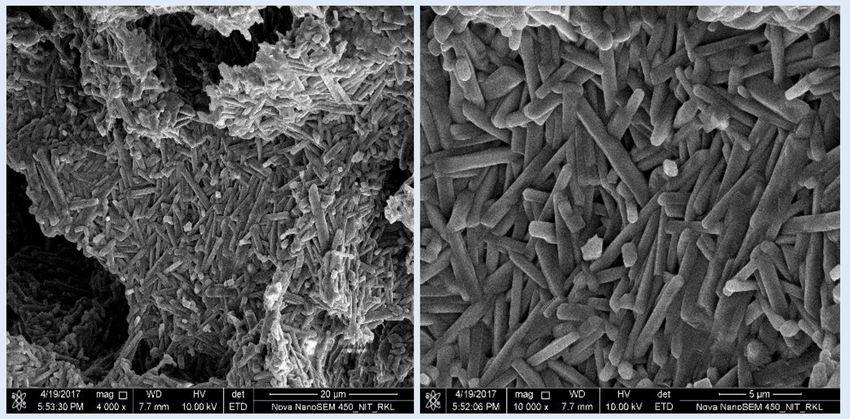


- XRD analysis of spherical mullite balls containing different amount of pore former and fired at 1600°C

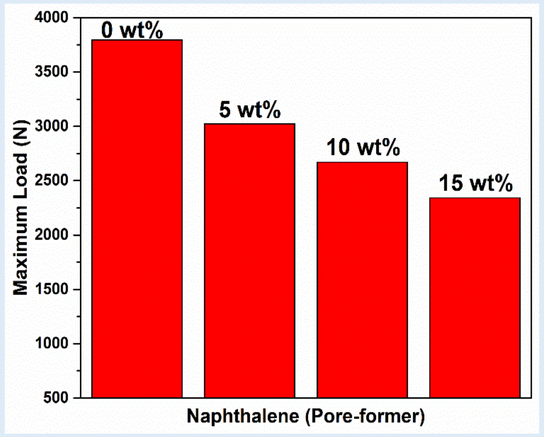


- Bulk density and apparent porosity as a function of wt.% of pore-former added

Microstructure and Point load strength test



- FESEM micrograph of fractured surface of 15 wt.% Naphthalene containing batch fired at 1600°C



- Variation in maximum load due to change in wt.% of naphthalene

Conclusion

- Porous ceramic balls using naphthalene as a pore former was successfully prepared which shows apparent porosity of around 45% and bulk density of 1.657gm/cm^3 at 1600°C with 15wt.% of naphthalene.
- XRD and microstructure analysis evident that lathe-shaped mullite was formed.
- Point load strength is also better in the case of 15wt% naphthalene, i.e., 2342N.
- According to the analysis it suggests that prepared mullite balls are proving good support for the heterogeneous catalyst with high porosity (for impurity filtration purpose) and good mechanical strength.

Acknowledgement

The financial support by the Science and Engineering Research Board (SERB/F/8796/2015-16), Government of India (project file no-YSS/2015/000856) is acknowledged

References

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