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SYNTHESIS OF MOF ADSORBENT

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ABSTRACT:

Metal organic framework (MOF) is a versatile material having antique properties and specifications such as its tunnel like structure and very high surface area which allows it to trap more material as compared to the any other material making it a better choice for the applications such as gas storage, carbon capturing, waste water treatment, drug injection and also in the sensors. The detailed study of this MOF indicated its excellent impact on the challenges like energy storage, safety sensors, environmental pollutions.

Due to its extraordinary properties ,its an flexible choice and a multi-dimensional option in various applications such as waste water treatment where it can be used to remove heavy metals present in it. MOF can also be used in the efficient drug delivery. It also has application in energy and the gas storage.

Introduction:

MOF'S are basically known as the metal organic framework which are created by attaching the organic and the non-organic molecules. With respect to the geometry, sizes and the functionability, there can be more than 15000-20000 different MOFs which are being reported and studied within the past few years.
Metal organic framework are the exclusive class of the crystalline materials having extremely high porosity and extraordinary surface area as compared to others. Its surface area can be beyond 6500m^2/g and the free volume upto 85-90%. Due to the combination of the organic and the non-organic materials, MOFs the subject of interest for applications in various fields such as in clean energy, storage medium for the various gases like hydrogen, methane etc, high capacity adsorbents for the treatment of the waste water, for the catalysis and also in the biomedical field like drug injections etc. MOFs are basically seeking the importance nowadays and optimize the glory of the mixing the organic and non-organic materials.
Generally MOFs had the mesh like structure and highly porous in the nature and have unique features due to its diverse and pleasing nature of the structure. Here we have selected copper based MOF and synthesised it. The method applied here to synthesis the MOF is solvothermal method.
There are various heavy metals in the industrial waste water. They can be very hazardous to the nature and the human life if they are left as it is in the waste water. There are various heavy metals such as nickel, chromium, aluminium, lead, manganese etc. If the concentration of such heavy metals in waste water is high then it has to be treated in filtration unit in order to remove or reduce the concentration to the permissible limit according to the norms of the pollution control board and the local authorities. Here the MOF can be the alternative for the filtration process in order to remove the heavy metals due to its ultrahigh porosity and the extra high surface area. The heavy metals can be trapped in the porous structure and hence the heavy metal content can be reduced to the greater extent.

Materials and Methods:

Materials:

Fig 1 Chemicals shown above

a) Cupric Nitrate Trihydrate

b) H_3BTC

c) DMF

Method:

I)Dissolution:

The solvo-thermal method is used here in order to form the Copper based MOF. The high purity chemicals were used to form the copper based MOF. The chemicals used were copper nitrate trihydrtate, H_3BTC, and the solvent Dimethyl formamide (DMF).

Now the 37.5 ml DMF solvent was taken in 100 ml beaker in which 1.5 gm of the copper nitrate trihydrate and 0.75 gm of H_3BTC was mixed in that beaker.

Dissolution is the process where bonds of the solute are broken and tend to dissolve completely in gthe solvent.

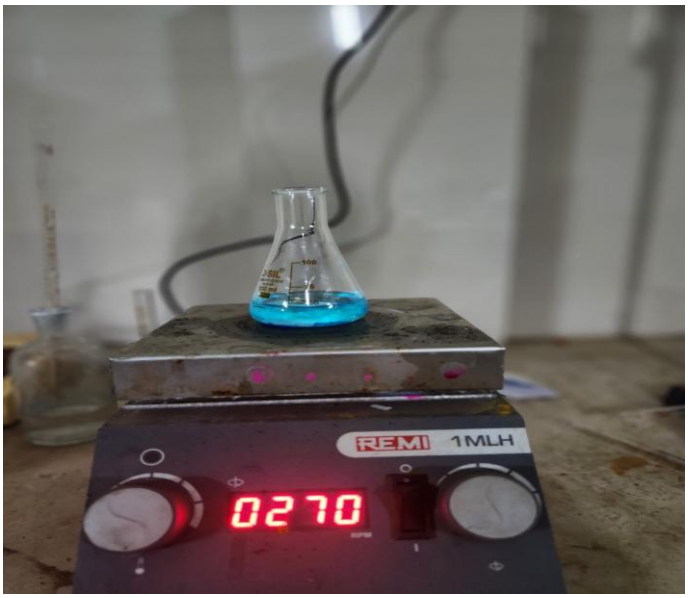


Fig 2 Quantity selection and dissolution process.

II) Heating:

The vessel is then placed in the stainless-steel autoclave for drying the solution at the constant temperature of 120^0C for 12 hours.

Fig 3 Dryer unit for heating purpose

III) Nucleation and Growth:

Nucleation is the process where the new atom or molecule starts to develop or new material forms, initially starting from disordered state to the more arranged or organized form. This molecule or nucleus further starts growing into a more developed form and a complete molecule is developed. The critical nucleus size is the impact factor affecting the growth of the nucleus.

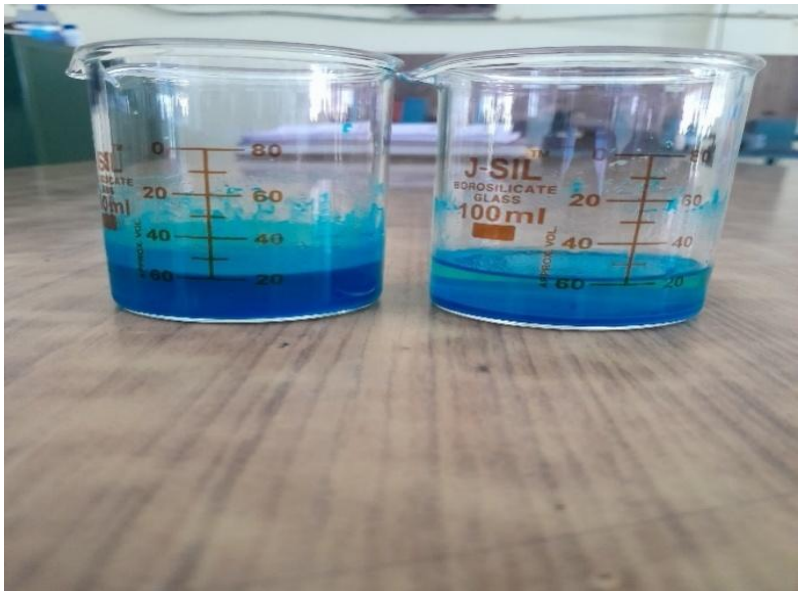
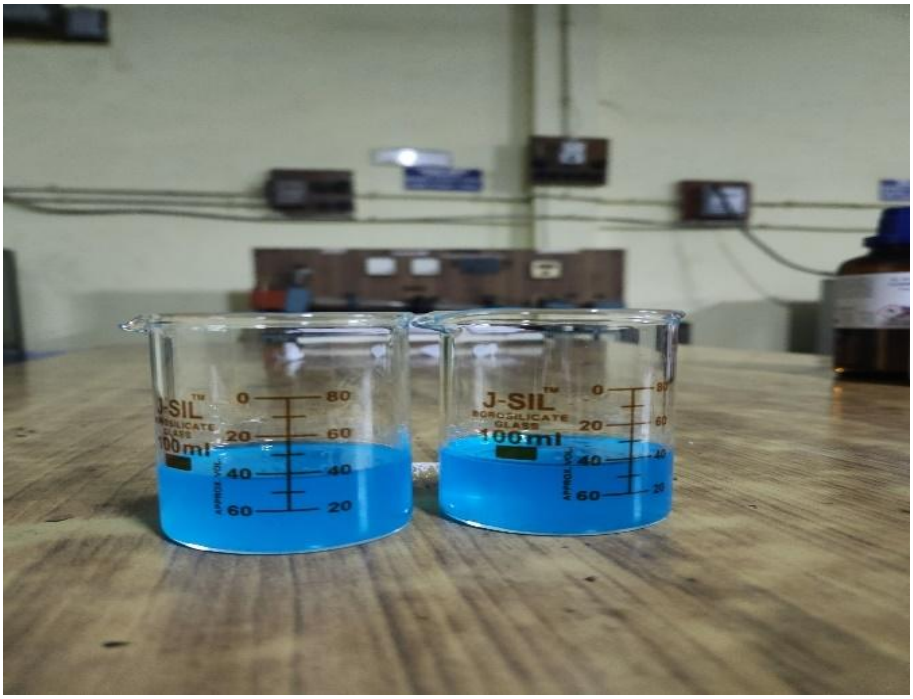


Fig 4 formation of MOF at bottom



IV) Cooling:

After the heating process, we let the solution to cool down to the room temperature.

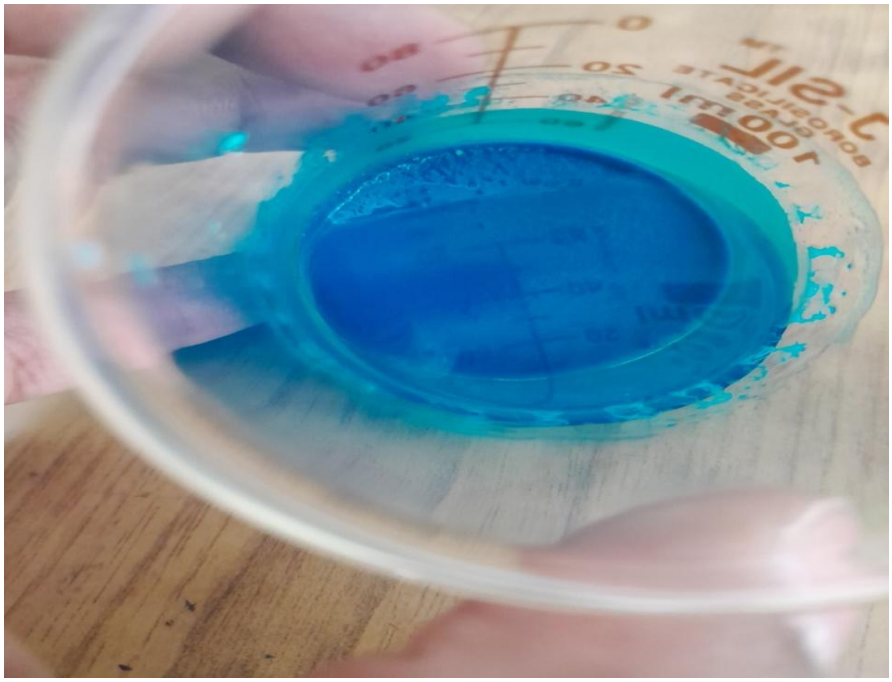


Fig 5 compilation of cooling

V) Filtration:

Filtration is the most basic and common method used in the labs and industries in order to separate the solid particles from the liquid. Here the solution is passed through the filter paper which blocks the solid particles and allows only liquid to pass down through the filter paper, retaining solids on the filter paper.

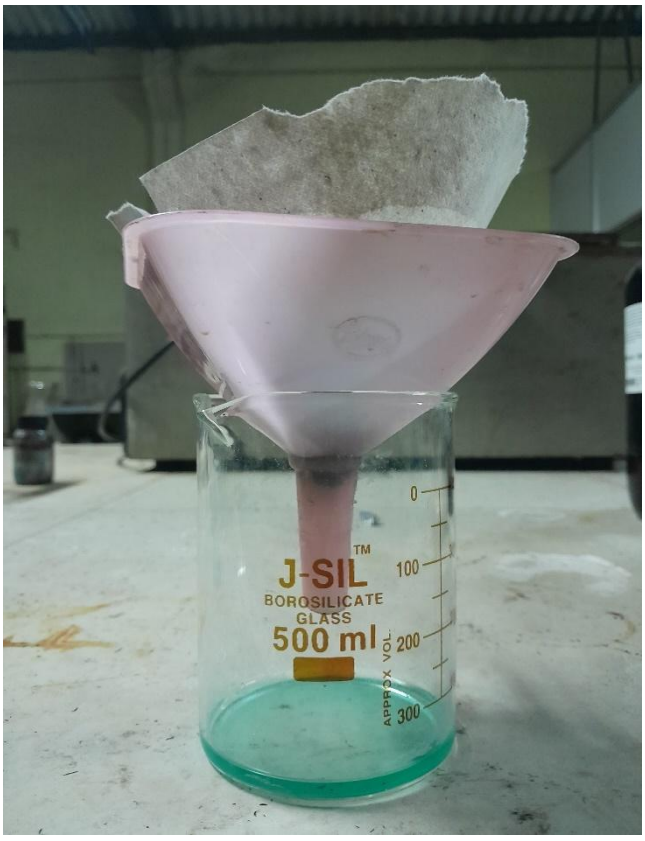


Fig 6 Filtration carried out by simple technique with help og filter paper.

VI) Washing and Drying:

The obtained MOF is then washed with the DMF solvent and dried in dryer unit to obtain powdered MOF.

Fig 7 Obtained Powder of MOF.

Conclusion:

In the conclusion, synthesis of metal organic framework represent a versatile and significant option across the various fields such as biomedical, gas storage, energy storage, carbon capture and in waste water treatment process. It has proved its abilities in various applications and has extremely high surface area favouring it in applications like carbon capture and waste water treatment. The MOFs modular structure makes it the valuable option in tackling the environmental mitigations.

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