Contribution ID: **470** Type: **Poster Presentation (120m)**

Synthesis of graphene blended activated carbon adsorbents for cryo-adsorption vacuum pump application and their thermal conductivity evaluation at 80 K

Tuesday 23 July 2024 14:00 (2 hours)

Adsorbents are an integral part of a cryo-adsorption vacuum pump. Activated carbon is the most efficient adsorbent material for such applications for a multitude of reasons like high surface area, versatile pore structure, chemical stability, and regenerative capacity. However, activated carbon does possess an inherent limitation of having low thermal conductivity, which is an essential vital factor that can enhance the pumping performance of a cryo-adsorption vacuum pump. Conductive adsorbents can enhance heat transfer within the adsorbent bed while cooling down to operational cryogenic temperatures and heating up during the regenerative process. This enhanced heat transfer capability ensures uniform and rapid adsorption-desorption processes, thereby optimizing overall pumping performance. Incorporating conductive metals such as copper, silver, or gold into activated carbon can enhance the thermal conductivity of the adsorbent bed but, this enhancement comes at the expense of reducing active adsorption sites of activated carbon. In this scenario, graphene can be the best candidate material as filler for thermal conductivity enhancement as it has high thermal conductivity
along with adsorption complementing features like large surface area, high strength, and chemical stability. The work reports the synthesis of graphene blended activated carbon by agglomeration and incipient wetness method, and their thermal conductivity evaluation at 80 K. The agglomeration technique utilized carboxymethyl cellulose (CMC), a water-soluble binder, to bind graphene onto activated carbon. Specifically, it employed coconut shell-derived 60 CTC-carbon powder (SURSORB 60 Carbon, from Suracsh Filters Pvt. Ltd.) and graphene in the form of platelets, stacked in a few layers (Grafino RG, from CUMI Murugappa). In contrast, the incipient wetness method utilized 50 CTC-activated carbon pellets (SURSORB 50 ACP,from Suracsh Filters Pvt. Ltd.) along with a water-soluble graphene dispersion (Grafino dispersion, from CUMI Murugappa) as the graphene source. Samples with graphene to activated carbon weight percentages of 0.5% and 1% were prepared using both methods. In the agglomeration method, the samples were shaped into 3mm pellets, while in the incipient wetness method, 4mm pellets were formed. The synthesized samples underwent thermal conductivity testing at 80 K using a Liquid Nitrogen (LN2) based dip experiment setup. Results revealed that samples prepared via the agglomeration method displayed thermal conductivity enhancements of 62% and 92% for 0.5% and 1% graphene to activated carbon weight percentages, respectively. Conversely, the sample prepared through the incipient wetness method with 0.5% graphene to activated carbon weight percentage, exhibited negligible thermal conductivity improvements, while the one with 1% graphene to activated carbon weight percentage showcased a 69% enhancement.

Acknowledgement
The authors gratefully acknowledge Suracsh Filters Pvt Ltd for providing the activated carbon samples utilized in this study. Additionally, we extend our appreciation to CUMI Murugappa for supplying the graphene samples. Their contributions were instrumental in the synthesis of graphene-blended activated carbon, which serves as a high thermal conductivity adsorbent material for cryo-adsorption vacuum pump applications.

Submitters Country

India

Author: NAZER K H, Abdul (Department of Instrumentation, CUSAT)

Co-authors: Mr SHIBU, Shone (Federal Institute of Science And Technology); Mr K J, Titus (Federal Institute of Science And Technology); Mr MARTIN, Paul (Federal Institute of Science And Technology); Mr M R, Sidharth (Federal Institute of Science And Technology); VENUGOPAL, Namitha (Cochin University of Science and Technology); KRISHNA RAJ, Hrithik; V K, Chinnu (Cochin University of Science and Technology); Mr ANTO, Tom

(Federal Institute of Science And Technology); Dr SAGAR, Pankaj (Cochin University of Science and Technology)

Presenters: NAZER K H, Abdul (Department of Instrumentation, CUSAT); Dr SAGAR, Pankaj (Cochin University of Science and Technology)

Session Classification: Tue-Po-1.4

Track Classification: Tracks ICMC Geneva 2024: ICMC 09: Insulation & Impregnation materials, processing and properties