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Nano-red mud filters to convert CO into CO_2

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The disposal of red mud (waste from aluminum industries) presents a huge environmental hazard. Around 13-15 million tonnes of red mud is generated per annum [1]. Moreover, its high alkalinity (pH ~12) limits its usage in further applications. Several methods have been employed till date for efficient use of red mud but have rarely succeeded. Presently, red mud is used in cement to enhance its load bearing capacity; in concrete to improve compressive strength (50 N/mm^2) [2]; in glass-ceramic tiles to have excellent glossy finish, good mechanical strength and abrasion resistance, adsorbent for water and gas, metal recovery (Fe, Al, Ti) [3].Carbon monoxide (CO) and Carbon dioxide (CO_2) emission from vehicle exhausts is of a major concern in present scenario. For this we propose the use of porous red mud filters which can entrap CO and convert it almost instantly into less toxic carbon dioxide (CO_2) ($k=19\ s^{-1}m^{-2}$). These filters are prepared using activated nano-red mud powders which reduces the pH from 12 to 8 [4].

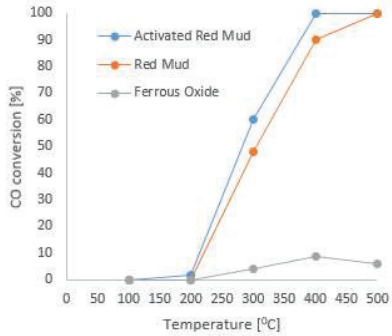

Figure 1: CO conversion over Activated Red Mud, Red Mud and Fe_2O_3 powder [4]

The activated powder is taken and mixed with starch in appropriate proportions. 3D printing is used to obtain 80% porous structure having a spherical pore size of 8mm. This structure when fixed in vehicle exhausts undergoes reaction: $Fe_2O_3(s) + 3\ CO(g) = 2\ Fe(s) + 3\ CO_2(g)$ at temperature of 500 ^0C, so as to convert CO into CO_2. CO_2 thus formed is later adsorbed in the porous red mud structure. Amount of CO converted into CO_2 and CO_2 adsorbed is then measured (Figure 1). For above reaction, Fe is not stable and instantaneously changes to Fe_3C. Removal of CO, adsorption of CO_2 and use of 3D printing makes the work environment friendly and cost-effective (figure 2).

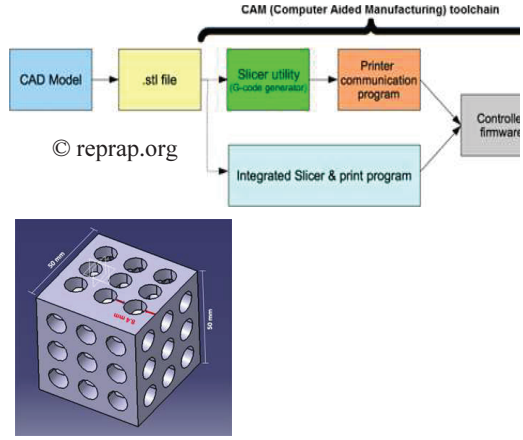

Figure 2: 3D printing process and CAD model of filter

Keywords: CO Filters, vehicle exhausts, activated red mud, 3D printing

References

1. S. Samal, A.K. Ray, A. Bandopadhyay, Proposal for resources, utilization and processes of red mud in India — A review, International Journal of Mineral Processing, 118 (2013), 43-45.
2. P. N. Bishetti, L. Pammar, Experimental study on utilization of industrial waste in concrete, International Journal of Technical Research and Applications, 2 (2014), 49-52.
3. S. Wang, H.M. Ang, M.O. Tade, Novel applications of red mud as coagulant, adsorbent and catalyst for environmentally benign processes, Chemosphere, 72 (2008), 1621-1635.
4. S. Sushil, V.S. Batra, Modification of red mud by acid treatment and its application for CO removal, Journal of Hazardous Materials, 203-204 (2012), 264-273.