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Short Communication

Application of Bentonite Mineral in Removal of Heavy Metals

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Bentonite deposits are widely distributed in different parts of the world associated with volcanic rocks and tuffaceous sediments of Miocene and Oligocene age. Other important minerals are illite, kaolinite and vermiculite. Bentonite mineral is smectite group of minerals having a montmorillonite unit which consists of two tetrahedral silica sheets and one octahedral sheet [1-3]. These come under clay minerals abundant in Rajasthan and Jharkhand. A vast deposit of bentonite occurs in a place Wyoming in U.S.A, Montmorillon in France, Japan and some countries of the world. So, this bentonite has been named after its place known as Wyoming bentonite and montmorillonite has gained its name after its discovery locality at Montmorillon 70 Km NNW of Limoges, France. Natural bentonite is 98% montmorillonite giving positive stain test with benzidine solution [4-6]. Owing to low cost and abundance in nature, a new vistas of research on bentonites has been opened up with a view to remove heavy metals and toxic elements from aqueous medium. Clay minerals have residual charges on the surface due to partial substitution of tetrahedral Si^{4+} by Al^{3+} or Al^{3+} or Fe^{3+} by Fe^{2+} or Mg^{2+}. Thus, substitution of tetravalent cations by trivalent cations leaves deficit charge on the surface of the clay. Main constituents of clay minerals are SiO_2, Al_2O_3 along with Na_2O, K_2O, CaO and MgO [7]. Characterization of bentonites are done by XRD, FTIR, SEM, TGA, DSC and physico chemical tests. Bentonites of different colour and grade of Rajmahal hills of Jharkhand have been used commercially for various industrial purposes. High swelling power, plastic properties, adsorption potential and cation exchange capacity of bentonite have made it a low cost adsorbent of Cr, Cd, As, F and organic dyes.

The presence of heavy metals in soil and water is posing a serious problem to the living beings due to toxicity and non-biodegradability. Some of the heavy metals e.g. Cr, Cd, Hg, Pb cause serious health hazards [8]. Hexavalent chromium is more toxic than trivalent chromium. Hexavalent chromium has been found a potential carcinogen due to modifying power of DNA resulting in chromosome aberrations. Cadmium is also a toxic inorganic pollutant whose large excess concentration in drinking water causes cancer, affects the kidney and lungs [9,10]. Needless to mention that heavy metals in general pose a serious threat to the environment and as a result researches are still going on in different laboratories to devise low cost and eco-friendly method of removal [11]. Experimental findings in my laboratory have established that bentonite is a suitable alternative for removal of heavy metals and toxic elements. In addition to the capacity for removal of heavy metals, the important applications of bentonite are decolorisation of oil, catalyst, production of oil well drilling mud, agriculture, suitability of decontamination of radioactive wastes, wine treatment and dye removal in textile industries. These industrial applications have added to the economic importance resulting in export of bentonite

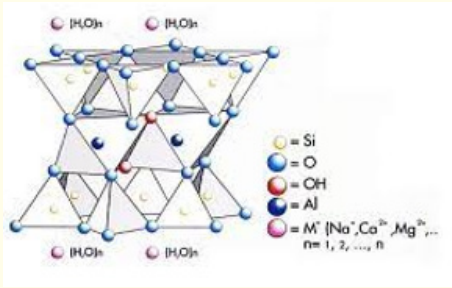

Figure 1: Structure of bentonite.

Methodology

The bentonites collected from different places of Rajmahal Hills were washed, dried and sieved to fine powder. The powdered mass was used as an adsorbent for hexavalent chromium. 2 ppm Cr(VI)

solution have been prepared by dissolving the salt in deionised water. Fixed mass of bentonite was taken in 50 ml 2 ppm hexavalent chromium solution up to different intervals of time. Thus the kinetics of adsorption have been studied for removal of Cr(VI). 0.5g of bentonite sample is taken in 50 ml 2 ppm Cr(VI) solution up to different intervals of time. It has been found that the Cr(VI) decreased up to 0.07 ppm in 120 mt with RHB_3 sample. RHB_3 stands for Rajmahal Hill bentonite. It is crystal clear that adsorption gives a linear equation.

Conclusion

Derivatives of bentonite and organo bentonite have been found to be more efficient for remediation of heavy metals from aqueous medium. Keeping in mind the industrial applications, capacity to adsorb and exchange cations, need has arisen to focus on the latest trends of research in this field.

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