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SCIENTIFIC CORRESPONDENCE

Crystal structure of HgFe_2O_4

Mercury contamination/poisoning is one of the most hazardous anthropogenic impacts that occurs in the environment. The literature survey reveals that because of the toxic nature of mercury, few researchers¹ had attempted the removal of mercury from water/wastewater. Though some were successful, disposal of the resulting highly saturated mercury sludge posed a problem for the ecosystem, because these methods involved only removal of mercury and none of them involved preparing a value-added product. The method described here not only removes mercury with greater efficiency than the prevalent methods quoted in the literature, but also converts it into a value-added product – HgFe_2O_4 (mercury ferrite). The porosity of HgFe_2O_4 was calculated from X-ray density and was observed to be –8.1. The ionic radii of both of its cations lie well within the range of spinel formation². Therefore, it could be expected that this compound crystallizes in the spinel structure.

An important feature of the present study is in successfully locking the mercury as HgFe_2O_4 by an economic process of

ferritization; co-precipitation of mercuric (Hg^{2+}) and ferrous (Fe^{2+}) ions was done with a dose of Fe^{2+} ions in the ratio of 1 : 2.5–3.2 with a solution containing Hg^{2+} ions, the pH of which was maintained between 9.5 and 10.2. The resultant solution was oxidized at 50°C by aeration. The resulting solution obtained after aeration contained precipitated hydroxides and this was further aerated. This aided the formation of the resultant compound, which crystallized by the process of ferritization³. The reaction time for the same was about 15 min. The ferruginous material thus obtained was then analysed by X-ray diffraction using CuK_α radiation ($\lambda = 1.5404$).

Crystallographic data revealed that the compound crystallized in orthorhombic symmetry having a non-spinel BaFe_2O_4 -type crystal structure⁴ with lattice parameters $a = 7.905 \text{ \AA}$, $b = 3.311 \text{ \AA}$ and $c = 4.876 \text{ \AA}$. Preference of Hg^{2+} ions for tetrahedral sites was attributed to the sharing of their electrons with 2P electrons of the oxygen ions. The observed symmetry may be due to slight difference in electro-negativity (<1.7) between Hg^{2+} and O^{2-} ions.

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