Wollastonite for toxic chromium removal

Courtesy Georgia Institute of Technology

Scientists use wollastonite for the remediation of hexavalent chromium from wastewater effluents

by Dr Susan Essien Etok, *Senior Assistant Editor*

SCIENTISTS AT THE Banaras Hindu University (BHU), India, have found that wollastonite is an efficient and economically viable material for the removal of toxic hexavalent chromium (Cr^{6+}) from industrial wastewater effluents.

Led by Dr Jogesh Sharma and funded by the Indian government, the project has now reached completion and the team at BHU are looking for potential industries that could implement wollastonite remediation systems in their operations and provide further funding for follow-up studies.

Chromium exists in various forms in the earth's crust, but from an environmental standpoint, hexavalent chromium is important. Toxicological studies by environment protection agencies worldwide have identified Cr^{6+} as a highly toxic substance – a human carcinogen. Exposure can also lead to health problems such as allergic skin reactions and intestinal ulcerations.

As a high priority environmental pollutant, Cr^{6+} has attracted the attention of researchers and industrialists internationally. Commonly used methods of detoxifying industrial effluents include solvent extraction, ion exchange, reverse osmosis, precipitation and adsorption on carbon.

Sharma told **IM**: "Toxic hexavalent chromium is a by-product of industries such as steel manufacture, leather tanning and paint manufacture. Current technologies used for its removal from wastewater are cost-intensive and therefore not suitable for developing nations."

"Some industries use industrial minerals such as feldspar, calcite, pumice, montmorillonite and China clay. However the problem is that these materials are not so efficient. Our study was driven by the need to find an economical and efficient method for the remediation of chromium; a solution that would benefit many industries."

Sharma told **IM**: "In my opinion, [wollastonite] is a better [remediation] material than others because it is efficient, non-toxic and naturally available. In India, it is indigenous and is readily available in regions such as Rajasthan."

Sharma, who has a PhD in applied chemistry, has been working on this project for the last 23 years. He explained to **IM** that Cr^{6+} particles from the wastewater adhere to the surface of the wollastonite. The key to its efficiency in removing the toxic metal lies in both its physical and chemical nature.

Wollastonite is a calcium inosilicate mineral ($CaSiO_3$) that often contains small amounts of iron, magnesium, and manganese substituting for calcium. It forms when impure limestone or dolostone is subjected to high temperature and pressure sometimes in the presence of silica-bearing fluids as in skarns or contact metamorphic rocks. Associated minerals include garnets, vesuvianite, diopside, tremolite, epidote, plagioclase feldspar, and calcite.

Sharma told **IM**: "Wollastonite has a large surface area and a porous structure. It contains mainly silica and calcium oxide, both of which are good adsorbents. It could be used very successfully as a remediation material and it incurs no extra financial burden on the users."

Other key findings from Sharma's research showed that unlike most adsorption processes, the present process is endothermic in nature and thus, higher removal rates can be obtained at higher temperatures. In addition higher removal rates can be achieved at low pH and concentration ranges.