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Chemicals cleaning water

Luis Wilfrido Atienza
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lw.atienza@gmail.com

Wastewater is a by-product of human activities, such as agriculture and industry. It is water that can be contaminated with any number of dangerous substances—dirt, bacteria, or chemicals such as heavy metals. Wastewater can pose a risk to all types of organisms, and looking for new and efficient ways to treat or remove pollutants from wastewater is an active and constantly evolving area of research.

Researchers from the University of the Philippines and the University of Houston have used a statistical technique called "response surface methodology," or RSM, to find the optimal chemical composition of a substance that can be used to remove heavy metals from wastewater samples. Their work is published in RSC Advances.

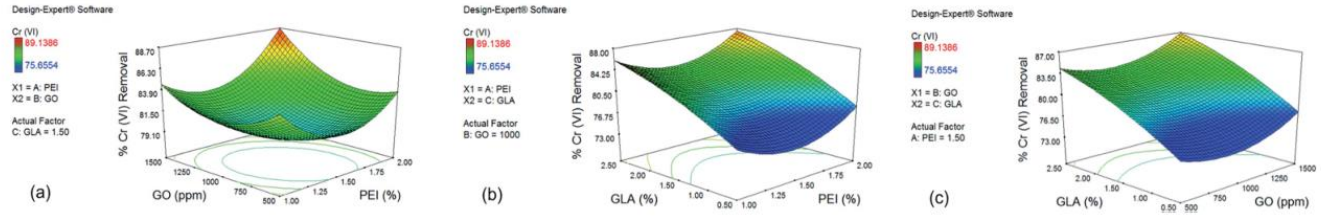
The scientists created in the form of beads a substance made up of three main chemicals: graphene oxide (GO), chitosan (CS), and polyethyleneimine (PEI). Each serves a different purpose in creating a substance that would effectively remove heavy metals from wastewater.

GO is a substance that will effectively bind with heavy metals, making it good for cleaning wastewater. However, GO is extremely small and will dissolve in water, making it very hard to separate once it is added. CS is much larger but more fragile than GO. Combining these two leads to a substance with the benefits of both. GO helps make CS more structurally stable, while CS makes GO less likely to dissolve in water. The addition of PEI increases GO's ability to bind with heavy metals, while also making GO more resilient against acidic conditions. These chemicals were combined and turned into beads, called CS-PEI-GO beads.

What these scientists tried to find out is the best combination that would lead to the most efficient decontamination of wastewater, specifically the removal of the heavy metals copper and chromium.

The researchers created different sets of beads, with different amounts of each substance. They added each set of beads to water contaminated with copper and chromium and stirred the water for 24 hours. The experiment was run 15 times, with different combinations of GO, PEI, and CS making up the beads, and the scientists observed how well each combination did at removing heavy metals from the water.

The data were then used to determine the ideal composition for these beads through RSM, mapping out relationships among several variables. In this case, RSM mapped out how the amount of each chemical in the CS-PEI-GO beads affected how much copper and chromium were removed from the water.



A visualization of how the amount of each chemical in CS-PEI-GO beads affects the amount of chromium removed from the water.

This study shows how statistical and mathematical tools such as RSM work in conjunction with real-life data to give scientists ways to design elegant solutions to problems such as wastewater management. The results are especially important in the Philippines. A heavily industrialized city with many commercial centers and factories, Manila produces a large amount of wastewater. Even outside Manila, wastewater can be a by-product of farms, for example. Finding effective ways to treat wastewater can help us reduce its adverse effects on the environment and on humans and animals. Finding new ways to treat wastewater can also give us more options in reusing water to protect our supply of clean water.

REFERENCE

Perez JVD, Nadres ET, Nguyen HN, Dalida MLP, Rodrigues DF. Response surface methodology as a powerful tool to optimize the synthesis of polymer-based graphene oxide nanocomposites for simultaneous removal of cationic and anionic heavy metal contaminants. RSC Adv 2017; 30:18480–90.

Luis Wilfrido Atienza graduated from the Ateneo de Manila University, with a BS in Biology, and a minor in poetry. He currently works as a copywriter for a sustainability agency, and spends some of his free time writing about science.