Optimizing the Removal of Methylene Blue from Aqueous Solution Using Cucurbita pepo and an Analysis of Desorption Efficiency and Material Reusability

Zhao, Serena (School: Manhasset High School)
Chen, Samantha (School: Manhasset High School)

Approximately 7 x 10^8 kilograms of dye are produced annually and 15% are released into aquatic bodies, causing global human and environmental health problems. Many conventional purification methods to produce potable water are expensive and inaccessible to lesser developed areas. This study produced efficient, low-cost adsorbent from Cucurbita pepo and optimized its use for adsorption of methylene blue (MB) from polluted water. A pyrolyzation temperature of 1300 degrees Fahrenheit and 1M NaCl chemical treatment, allowing Na+ activity to increase surface area and functional group activity, were optimal for adsorbent development. Adsorbent in 0.5 g mass / 50 mL MB solution was most efficient in improving water quality, resulting in 100% dye removal across all treatment groups. The effect of adsorbent size fraction, solution pH, and agitation and adsorbent reusability after desorption (1M NaOH/NaCl with different agitation conditions) were studied via exposure to 4 ppm MB solution for 48 hours. Adsorption capacities and reusability of self- and commercially-produced activated carbon were compared. Data was collected via spectrophotometry and processed with a Beer's Law Plot. Mixed size fractions resulted in most efficient removal (100% after 48 hours) due to an interstitial maximization of surface area. pH and agitation had no significant effect due to the adsorbent's carbonaceous nature and porous structure. The novel, affordable adsorbent is highly efficient, with 32% greater adsorption capacity than commercially-produced carbon, and environmentally sustainable due to its reusability as well as accessibility of agricultural waste material and NaCl.

Awards Won:
Third Award of $1,000