

Design and Operation of a Scaled-Up Pilot Plant for the removal of Sugar Beet Extract Colorants using Powdered Activated Carbon

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ABSTRACT

A pilot-scale filtration unit has been modified and operated at the Southern Regional Research Center of the US Department of Agriculture for scaled-up trials to test the efficacy of powdered activated carbon in the removal of color impurities from sugar beet extract (SBE). As a by-product of sugar beet processing, additional sucrose can be recovered from high color SBE by recycling it from the chromatography system back into the crystallization unit. Large amounts of color compounds can make this process unfeasible. Color and other impurities can be reduced prior to further processing into white refined sugar, by application of high surface area powdered activated carbon (PAC). Pilot-plant trials were undertaken to determine the feasibility of using PAC to adsorb both natural and process-induced colorants from SBE. Experiments were performed using a batch decolorization process to maximize color removal and determine optimal PAC distribution as either body feed or filter pre-coat. With initial colors at 4275 ± 114 , 4256 ± 223 and 4774 ± 157 ICU for color measured at pH 4, 7 and 9, respectively, a target of 50% color removal was achieved using 4000 ppm on volume of PAC, with a recommended distribution of 75% as pre-coat in the filter and 25% as body feed in the feed tank. A 50/50 PAC distribution also reached the target color removal rate. A “merry-go-round” experiment was undertaken to simulate a semi-continuous process to achieve continuous color removal over time. Overall, PAC performance was slightly better for the removal of native sugar beet colorants than colorants produced during processing. Addition of PAC did not lead to significant sucrose losses nor affected the pH of beet extract.

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