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Application of spent coffee grounds in water treatment for hemodialysis by adsorption of residual chlorine

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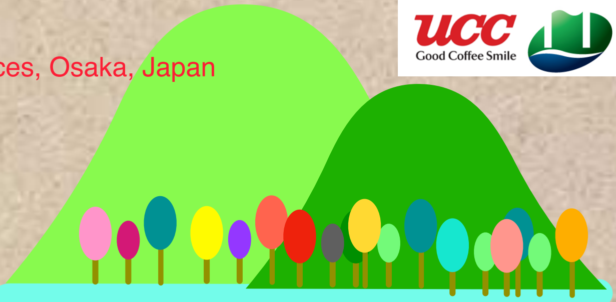
UCC Good Coffee Smile



INTORDUCTION

We evaluated the use of spent coffee grounds, which are otherwise difficult to dispose, for treating water used for hemodialysis (HD) in the medical field. HD is performed thrice a week per patient, and one treatment requires a large amount of dialysate (approximately 120–150 liters). The water used for preparing the dialysate is obtained from tap water or wells and requires the prior removal of various contaminants to generate high-purity water. In particular, chloramine and residual chlorine present in tap water cause hemolysis when mixed into the blood via the dialysate. Chloramine and residual chlorine in tap water are generally adsorbed and removed using a coconut shell-activated carbon filter. Activated carbon is usually produced by the thermal decomposition of raw materials and subsequent activation using acid gas, which is a multi-step and costly process. We investigated whether the carbides of coffee residue could be used as an alternative to the coconut shell-activated carbon filter for treating water used for HD.

clean water

coffee grounds

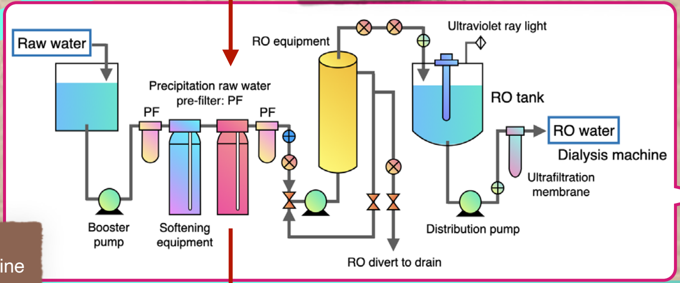
CONCLUSIONS & PERSPECTIVES

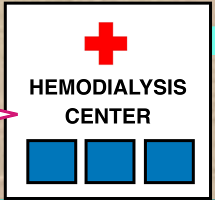
This study showed that carbonized coffee grounds adsorbed bound chlorine (chloramine) and free chlorine. Coffee grounds can be potentially used for the treatment of tap water in HD. Coffee grounds can also be used in times of disaster or in areas with inadequate means of water treatment for preparing dialysis pipe disinfectant solutions containing NaOCl. In terms of functional properties, coffee grounds exhibit good adsorption ability. Ease of availability and a simple carbonization process make coffee grounds a promising candidate for use in HD treatment.

Damaged sewer pipe by dialysis drainage

METHODS

Coffee grounds were heated at about 400-500 °C to produce carbide in an electric furnace. The carbide (10–50 g) was mixed in 200 mL of a 400–1000 ppm (0.04–0.1%) sodium hypochlorite (NaOCl) solution for 5–30 min, and the concentrations of bound and free residual chlorine were measured using the N,N-diethyl-p- phenylenediamine method.





coffee grounds

waste liquid

RESULTS

The concentration of bound and free residual chlorine in the NaOCl solution was 0 mg/dL in all conditions.

Activated charcoal filtration equipment

References: McNutt, J.; He, Q. Spent coffee grounds: A review on current utilization. J. Ind. Eng. Chem. 2019, 71, 78–88.