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Comparative analysis of sorbents within the landfill leachate pretreatment process

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ABSTRACT

A proper management of leachates, including their treatment and pretreatment, constitutes a challenge for the operators of landfills. A known method of the treatment of leachates is the adsorption. Responding to the need for reasonable management of raw materials and energy, waste is used as substitutes of commercial sorbents. The laboratory tests on the pretreatment of leachates from the landfill in Janczyce included the following compounds: zeolite (Z), activated carbon (AC), shungite (S), walnut shells (WS), spent coffee grounds (SCG) and sewage sludge (SS). The research allowed to determine the influence of the contact time (10, 20, 40, 80 and 160 min) on the chemical oxygen demand (COD), the colour, the dissolved organic compounds and heavy metals at adsorption dosage (5, 10, 20, 40 and 80 g·L^{-1}). The kinetics and isotherms of the adsorption were determined. Better effectiveness of the activated carbon was discovered for the removal of the colour of the leachate and the reduction of the COD in comparison to the shungite and zeolite. Satisfactory effectiveness of sewage sludge, spent coffee grounds and walnut shells was not found for the remediation of landfill leachates. The highest effectiveness of the removal of the COD (13.5% for SS and t = 10 and 20 min; 19.9% for WS and t = 160 min; 12.9% for CG and t = 10 min) and the colour (34.9% for SS and t = 10; 26.6% for WS and t = 20 min) for alternative sorbents was obtained for 5 g·L^{-1} dose. Higher doses and longer time cause the deterioration of the initial parameters of the landfill leachates. More favourable effects of the removal of the COD were obtained for shungite (76% for D = 80 g·L^{-1} and t = 160 min), activated carbon (75.5% for D = 80 g·L^{-1} and t = 10 min) and zeolite (57.5% for D = 40 g·L^{-1} and t = 80 min). In the aspect of the elimination of UVA(254), the greatest results were obtained for activated carbon (99.97%, D = 40 g·L^{-1}, t = 160 min), shungite (74%, D = 80 g·L^{-1}, t = 40 min) and zeolite (14.5%, D = 80 g·L^{-1}, t = 160 min). In the aspect of the elimination of the colour, the greatest results were obtained for activated carbon (99.14%, D = 80 g·L^{-1}, t = 60 min), while slightly weaker effects were obtained for shungite (80.5%, D = 80 g·L^{-1} and t = 80 min) and zeolite (69.25%, D = 80 g·L^{-1}, t = 80 min). An improvement of the adsorption properties of sewage sludge, spent coffee grounds and walnut shells can be realised by proper conditioning.

Keywords: Landfill leachate; Adsorption; Zeolite; Activated carbon; Shungite; Walnut shells; Spent coffee grounds; Sewage sludge; Sorbents

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