Optimizing the coagulation/flocculation process for the treatment of slaughterhouse and meat processing wastewater: experimental studies and pilot-scale proposal	
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Abstract: The slaughterhouse industry generates substantial wastewater rich in proteins, lipids, fibers, and carbohydrates. This study integrates experimental investigations into artificial neural network (ANN) optimization and commerce design studies for treating slaughterhouse and meat processing wastewater (SMW). Batch coagulation/flocculation experiments identified optimal conditions for three coagulants: Ferric Chloride (FeCl3·6H2O), Poly Aluminum Chloride (PAC), and Aluminum Sulfate Al2(SO4)3, aiming for optimum removal of chemical oxygen demand (COD), total suspended solids (TSS), and total nitrogen (TN) from SMW. Results indicate PAC's superior efficacy, achieving remarkable removal rates of 74.6% for COD, 82.0% for TSS, and 89.1% for TN. These optimal outcomes were observed under specific conditions: pH 7, a dose of 100 mg/L, rapid mixing at 200 rpm for 1 min, followed by slow mixing at 30 rpm for 20 min, and a settling time of 30 min. An ANN model was built, trained, and validated in MATLAB to predict removal efficacies of contaminants using PAC coagulant. It considered variables like dosage, rapid/slow mixing conditions, settling time, and pH. The ANN model showed a high performance through multiple metrics, including total regression (R) of 0.91, 0.95, and 0.87 for COD, TSS, and TN, respectively. The linear regression results demonstrate a strong agreement between the predicted values and the experimental values, affirming the excellent performance of the ANN models. The treatment system, designed for 69.44 L/min of SMW, features concrete tanks for durability. It includes a 75-L rapid mixing tank (200 rpm), a 1500-L clariflocculation unit (30 rpm) for efficient wastewater management.