Deep neural network-based cost optimization of wet flue gas desulfurization system using waste sea shells to solve the high-grade limestone depletion

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In this study, we proposed the cost optimal selection and blending ratio of waste sea shells as high-grade limestone substitutes through cost optimization using deep neural network (DNN)-based surrogate model. Derivation of the cost optimal blending ratio is proceeded to the following procedure. First the process model to generate dataset is developed and the dataset is gypsum purity according to blending ratio. To calculate the total annualized cost (TAC), the mathematical model is proposed and the TAC is added to the dataset. Second, the generated dataset is preprocessed based on the z-score normalization. Third, to predict the gypsum purity and TAC according to blending ratio, DNN-based surrogate model is developed. Finally, cost optimal selection and blending ratio is derived under the two constraints: gypsum purity and total SO_x absorbent consumption. As a results, the cost optimal blending ratio derived to low grade limestone (80.86 %), oyster shell (10.78 %), scallop shell (0.216 %), cockle shell (0.323 %), clam shell (2.426 %) and mussel shell (5.391 %).

Keywords: Wet flue gas desulfurization system, waste sea shell, cost optimization