Three-dimensional Modeling of Mud Loss Zones Using the Improved Gustafson-Kessel Fuzzy Clustering Algorithm (Case Study: One of the South-western Oil Fields)

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Abstract

Several factors can be affected the lost circulation, which the modeling of all items is complex. In this research, the fuzzy zoning is presented according to the fluid mud loss and using the improved Gustafson-Kessel fuzzy clustering algorithm. It is capable to model complex processes and integrate the various layers of information. To evaluate the algorithm, different information layers including circulation losses, geological zoning and drilling mud weight (with respect to the spatial location of the studied features) were utilized and four combinations of different information layers were considered. To determine the optimal number of zones, we employ the various fuzzy validity indices comprising in comparison with Partition Coefficient (PC), Classification (Partition) Entropy (CE), Partition Index (SC), and Xie and Beni›s Index (XB). The best combination of information layers was determined consisting of mud loss, and geological zoning regarding to the coordinate of the samples, the optimal number of zones was computed as 12 zones and the optimal fuzzy exponent was obtained about 1.1. In the improved Gustafson-Kessel fuzzy clustering algorithm, weighting factor was employed for scaling between the covariance of all data and within clusters, and the optimal value was determined as 0.4. Finally, three-dimensional fuzzy zoning in the studied field was executed and the Fisher›s discriminant analysis was approved that the obtained zoning from clustering method was better performance than the common geological zoning (Fisher index 0.088 vs. 0.011) for modeling and zoning the mud loss.

Keywords: Drilling Mud Loss, Fuzzy Zoning, Gustafson-Kessel Clustering Method, Asmari Reservoir, Iran