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A Modified Simplified Local-Density Model for Gas Adsorption Considering Cylindrical Pore Structures

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Recent developments in unconventional oil and gas reservoirs such as shale gas have brought the pore structures and gas adsorption characteristics into focus. Traditional models, such as the original Simplified Local-Density (SLD) model with a slit-shaped pore, fall short in accurately describing gas adsorption in these reservoirs due to the presence of various carbon pore geometries, including slit and cylindrical shapes. In this study, we develop a modified SLD model, specifically adapted for circular shale nanopore geometries. Such model, based on cylindrical pore structures, incorporates a modified attractive parameter to account for the curvature effect on gas adsorption behavior. We validate the model's efficacy by examining the isobars and isotherms of methane over a wide range of temperature and pressure in various cylindrical pores.

The results demonstrate that the adsorption isotherm and density profile calculated by the modified SLD model are in strong agreement with experimental data. Furthermore, such modified model effectively captures the methane adsorption isotherm observed in shale, demonstrating its superior capability in characterizing pore structures within unconventional gas reservoirs.

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