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Editorial: Cleaner Treatment Technologies and Productions in the Energy Industry

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Editorial on the Research Topic

Cleaner Treatment Technologies and Productions in Energy Industry

As the rapid development of world's economy brought serious environmental problems, the economy must accelerate the adjustment of industrial structure and the transformation of development mode in order to achieve sustainable development. Cleaner production mode based on cleaner technology is a crucial way to effectively solve the conflict between economic growth and environmental protection. In essence, cleaner production is a kind of production mode in which the environmental strategy of overall prevention is adopted for the production process to reduce or eliminate their possible harm to human beings and the environment, while fully meeting human needs and maximizing social and economic benefits.

Fossil energy and renewable energy have promoted the development of a large number of emerging industries, such as automobile industry, aerospace technology, modern production and processing, and modern transportation industry, and preventing the production of waste, while increasing efficiencies in the uses of energy is a very important issue. Specific measures include: using clean energy and raw materials; adopting advanced technology and equipment; comprehensive utilization; reducing pollution from the source; improving utilization efficiency; reducing or avoiding the generation and emission of pollutants in the process of production. This special issue aims to reports the most important and latest technological advances in cleaner treatment technologies of fossil energy (such as oil and natural gas) and renewable energy (such as hydrogen energy and geothermal energy), and serves as a platform for addressing and discussing theoretical and practical cleaner production.

How to develop the gas reservoir well is a main task for petroleum engineers. High-pressure abrasive water jet flushing is an effective method used to improve coal seam permeability. A coupled gas-rock model is established to investigate realistic failure processes by introducing equations for the evolution of mesoscopic element damage along with coal mass deformation. The gas pressure of the slotted soft coal seam is reduced and that the gas drainage volume is three times higher than that of a conventional borehole. The soft coal seam is significantly improved and that tunneling speed is nearly doubled (Zhang et al.). Considering the processing capacity, processing cost, floor area, construction cost of modular equipment, and the changes of market supply and demand, an optimization model is established, which can optimize the layout of modular equipment, make the modular equipment run efficiently and economically, reduce costs, and increase efficiency (Hong et al.). During shale gas reservoir development, BET multimolecular adsorption, considering the shale gas surface fractal dimension theory to describe the adsorption properties, can describe the adsorption surface as a multimolecular layer and regard adsorption using a fractal dimension,

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describing the adsorption property of shale gas more accurately (Qiu et al.). Coalbed methane (CBM) is one of the important unconventional oil and gas resources. It is meaningful to analyze the wellbore pressure response of the off-center fractured vertical wells with asymmetrical fracture. The wellbore pressure includes six flow regimes, which include bilinear flow, linear flow, elliptic flow, radial flow, arc boundary reflection, and boundary dominated flow regime (Ji et al.).

Carbon Capture and Storage (CCS) processes remove carbon dioxide (CO_2) that would otherwise be emitted from fossil fuel and other energy industrial processes and transport it for permanent underground storage. A comprehensive understanding of the effects of CO_2 dispersion pattern after release from CCS facilities is essential to allow the appropriate safety precautions to be taken. It was found that shrubbery affected the flow field near the ground, enhancing the lateral dispersion of CO_2 (Wang et al.). Supercritical CO_2 pipelines usually are used to link the CO_2 capture system to the geological storage. The flashing-spray jet structures of supercritical CO_2 from circular and rectangular orifices were recorded by a high-speed camera. The near-field structures of supercritical CO_2 jet from circular and rectangular orifices are totally different, which causes the different dispersion consequences (Teng et al.). The existence of inert gases such as N_2 and CO_2 in biogas will reduce the proportion of combustible components in syngas and affect the combustion and NOX formation characteristics. The effect of CO_2 concentration in biogas on NO_2 is complicated, when the combustion reaches the chemical equilibrium, the flame combustion temperature and flame propagation speed decrease with the increase of CO_2 concentration, and the flame propagation speed decreases even more slowly (Ma et al.).

Recently, several countries have conducted projects to explore and develop natural gas hydrate, which is one of the new alternative energy resources for the future. Methane hydrates formed inside porous media with different saturations were dissociated by depressurizations. These formed hydrates at higher temperature and pressure, and possess a higher saturation, and the nonuniformity of dissociation processes at different layer positions induced by depressurization is inhibited significantly (Chen et al.). The phase equilibrium curves of the methane containing systems are mainly related to the guest molecule type and the composition of gas. The evolution law of phase equilibrium pressure of different gases varies with composition and temperature, and the phase splitting of CO_2 at the quadruple point affects the phase equilibrium conditions (Liang et al.).

The safety and integrity of pipeline systems plays a crucial role in oil and gas transportation field. Variation in the thermo-physical properties of an H_2-natural gas blend will impact the performance of pipeline appliances, thus, a one-dimensional pipeline model is proposed to predict the blended flow in a real existing pipeline, the influence of H_2 fractions on pipeline energy coefficient and the layout of pressurization stations are comprehensively analyzed (Liu et al.). Thawing landslide is a common geological disaster in permafrost regions, which seriously threatens the structural safety of oil and gas pipelines crossing permafrost regions. An improved analytical method is introduced to accurately analyze the longitudinal strain characteristics of buried pipelines subjected to slope-thaw slumping load (Ji et al.). The fluctuation of pressure and flow caused by slug flow has an important impact on deep-sea oilfield and the design of production equipment. During the movement of the slug head, there is a throwing phenomenon and a wave-like motion of the liquid slug. In addition, the slug tail and body area have very similar velocity profiles, and the overall velocity field distribution becomes more uniform with the development of liquid slug (Wu et al.). ABAQUS software is used to establish a pipe–soil model of variable wall thickness butt welds of suspended pipelines. The axial stress distribution with different affected factors in the pipe, the change of curvature, and Mises stress change of the entire pipe along the axial direction are obtained by analyzing the internal pressure, wall thickness ratio, suspended length, weld position, and cone length (Fang et al.).

Heat and mass transfer theory and numeric calculation model are widely used in energy industry. The additional operation of deaeration (compaction) of powders affects the quality of many products of chemical industries. A plane-deformation model is described, neglecting the forces of interphase interaction and taking into account the compressibility of a solid-particle-gas mixture without elastoplastic deformations (Kapranova et al.). Flow separation commonly affects the stability of turbomachines, especially under low-flowrate conditions. The singularity characteristics of the blade surface separation are analyzed using a topological approach. The flow separation is explored in three-dimensional space using a topological-mapping method (Liang et al.). A novel impeller with splitter blade structure is proposed, and the impeller with splitter blades not only can reduce the energy loss of the slurry pump, but also enhance the wear characteristics of impeller under two-phase flow conditions (Peng et al.). High-pressure abrasive water jet flushing (HPAWJF) is an effective method used to improve coal seam permeability. A coupled gas-rock model is established to investigate realistic failure processes by introducing equations for the evolution of mesoscopic element damage along with coal mass deformation (Zhang et al.). To study the heat exchange rate between the heating medium water and the fire and gas tubes in the great-capacity cylinder, the discrete-ordinate model is utilized to build a 2-D combined natural convection and participating medium radiation heat transfer model, which is solved using the finite volume technique with unstructured body-fitted grids (Guo et al.). The response analysis for transient heat transfer at fluid-solid interface was conducted by applying the concept of penetration depth. It is considered that, when the penetration depth is smaller than the thermal boundary thickness, the heat transfer from the interface (wall surface) to the fluid domain is not fully developed during the disturbance (Wang and Liu). The copper slag modified through calcining in redox condition was proved to be a promising oxygen carrier in chemical looping process (Fang et al.). In the single-stage mixed refrigerant liquefaction process, reducing the feed gas temperature and increasing the feed gas pressure can reduce the total power consumption, exergy loss, freezing mixture circulation, and cooling water load, which can significantly improve liquefaction performance (Wu et al.).

AUTHOR CONTRIBUTIONS

JB is an associate editor of Frontiers in Energy Research and a guest associate editor of the Research Topic and wrote the paper. XC is a guest associate editor of the Research Topic and edited the paper. LT is a guest associate editor of the Research Topic and reviewed the paper.

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