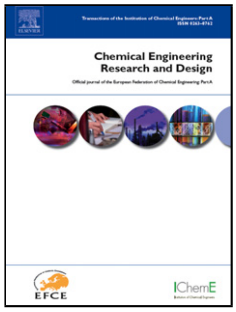

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Incorporation of Sustainability in Process Control of Hydraulic Fracturing in Unconventional Reservoirs

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Highlights

- Dynamic modeling of the flow rate and TDS concentration of flowback water
- Designing of the hydraulic fracturing superstructure that minimizes TAC
- Case studies to examine the effect of water availability on the well productivity
- Evaluation of the environmental impact of flowback water using TRACI

Abstract

Typically, the term shale oil refers to natural oil trapped in rock of low porosity and ultra-low permeability. What has made the recovery of shale oil and gas economically viable is the extensive use of hydraulic fracturing. Research on the relationship between the distribution of propping agent, called proppant, and shale well performance indicates that uniformity of proppant bank height and suspended proppant concentration across the fracture at the end of pumping determines the productivity of produced wells. However, it is important to note that traditional pumping schedules have not considered the environmental and economic impacts of the post-fracturing process such as treatment and reuse of flowback water from fractured wells. Motivated by this consideration, a control framework is proposed to integrate sustainability considerations of the post-fracturing process into the hydraulic fracturing process. In this regard, a dynamic model is developed to describe the flow rate and the concentration of total dissolved solids (TDS) in flowback water from fractured wells. Thermal membrane distillation is considered for the removal of TDS. An optimization problem is formulated to find the optimal process that consists of hydraulic fracturing, storage, transportation, and water treatment, through minimizing annualized cost and water footprint of the process. The capabilities of the proposed