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DEGRADATION OF DRAG REDUCING POLYMERS; EXPERIMENTAL ANALYSIS

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Abstract: Drag reducing polymers are evaluated by their resistance against mechanical shear forces. Higher amounts of drag reduction as well sustainability under turbulent conditions make a polymer as an efficient drag reducer. This study compares the performance of two drag reducing polymers with linear backbone under turbulent flow in a laboratory scale pipe line. Two commercially available water soluble well-known polymeric agents, polyacrylamide and polyethylene oxide, were added to the turbulent flow of water. Variation of pressure drop in the pipe line was then measured for 2 hours to compare the effect of diluted polymeric solutions with the one with water. Polyacrylamide showed better performance compared to polyethylene oxide in terms of both degradation and drag reduction percentage. An experimental analysis with Response Surface Methodology (RSM) to the historical data was then employed to analyze the data.

Keywords: turbulent flow; drag reduction; degradation; design of experiments (DOE); Response Surface Methodology (RSM)

1. INTRODUCTION

Drag reducing agents (DRA) are the additives which can effectively decrease friction losses of flow. DRAs have found a great potential to avoid negative consequences of pressure losses in many industrial processes and laboratory cases. DRAs may suppress the energy of turbulent eddies and hence decrease the friction factor [1]. As a practical result in the pipelines, this kind of additives reduces the required pump power at a constant flow rate, or increases of the piping system capacity at constant pressure drop [2]. After Toms [3], who introduced this concept through his studies, drag reduction is known as Toms' effect in the literature. The desirable effects of DRAs in turbulent flow have attracted many researchers to describe the concept of drag reduction and develop its applications over decades. Consequently, many studies have been carried out to understand the various aspects of the phenomenon and to adequately utilize drag reducers [4-15].

Various agents such as high molecular weight polymers, surfactant soap, suspensions of particles or fibers, and micro-bubbles show their potential as drag reducer [2]. In addition to these additives, the resulted pressure losses in both laminar and turbulent flow can be avoided by employing compliant coating on the surface [16]. Under turbulent flow conditions, fluid soluble ultrahigh molecular weight polymers with a linear structure are considered the most effective drag reducing agents in both aqueous and organic phases. The following properties define polymers as efficient drag reducing agents: