The Cost Estimation of CO\textsubscript{2} Pipeline Transport for the Offshore CCS in Korea

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ABSTRACT

This study estimates the CO\textsubscript{2} pipeline transport cost and corresponding pipeline designs which is applicable for the offshore CCS in Korea. The CO\textsubscript{2} capture plants of Scenario 1 and 2 are Boryeong power plant, and both Boryeong and Samcheok power plants, respectively. The offshore storage site of all Scenarios is fixed to Ulleung basin. The estimated transport costs of Scenario 1 at transport rate of 1 MtCO\textsubscript{2}/y and at 3 MtCO\textsubscript{2}/y are ~ USD 18/tCO\textsubscript{2} and ~ USD 9/tCO\textsubscript{2}, respectively. In the case of Scenario 2 at capture rates of 1 MtCO\textsubscript{2}/y at each capture plants, the transport cost is USD ~13/tCO\textsubscript{2}.

KEY WORDS: CCS; pipeline; transport; cost.

INTRODUCTION

It takes a large amount of cost and electricity to build and operate the Carbon Capture and Storage (CCS) project. Many PPs based on fossil fuel are expected to adopt CCS to meet the CO\textsubscript{2} emission reduction goal. However, adopting of CCS can increase the electricity rates and government may suffer from lack of tax. Therefore the accurate estimation of CCS cost is very important in building national policy and electric power industry. The estimation of CO\textsubscript{2} capture cost is relatively straightforward and many studies about the CO\textsubscript{2} capture cost have been carried out. However, studies about the CO\textsubscript{2} transport cost are complicated especially in case of many capture plant and storage site, and relatively few studies have been carried out.

This study adopts two PPs as capture sites and one offshore saline aquifer as a storage site and detailed locations are shown in Fig. 1. Two capture plants are Boryeong and Samcheok Powr Plants (PP) where CO\textsubscript{2} capture rate is like to be more than 1 MtCO\textsubscript{2}/y, and storage site is Ulleung Basin where its storage capacity is estimated to around 5 GtCO\textsubscript{2}. (Kim et al., 2012)

When calculating CO\textsubscript{2} pipeline transport cost, most of previous studies used the empirical models based on pipe diameter. It is evident that the pipe diameter is the most important factor in the cost of pipeline transport. However, to optimize the pipeline transport, the pressure drop in the pipe, inlet pressure, number of booster station, pipe materials and pipe thickness should be considered together.

Assumptions about pressure and temperature condition are made first and lest cost spec of equipment are determined as optimum value. We note that this study is not for commercial scale CCS project but demonstration one. This study calculates the CO\textsubscript{2} transport cost at various transport rates. In the pipeline transport cost calculation, most cost effective pipe diameter, thickness, materials and pipeline pressure are simultaneously determined.

TRANSPORT SCENARIOS

Scenario 1 has only one capture plant, Boryeong, and Scenario 2 has two capture plants of Boryeong and Samcheok. Scenario 2 includes hub terminal at Ulsan but Scenario 1 do not. The detailed transport distances are shown in Table 1.

In the case of Scenario 1, to avoid the large mountains that are located in the center of Korean Peninsula, the transport route from capture plant to storage site is not the shortest route but follows the plain areas around the coastline as shown in Fig. 2. In Scenario 2 Boryeong and...