NITROGEN DRYING AND PURGING DYNAMIC SIMULATION OF 200,000 m³ LNG STORAGE TANK

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INTRODUCTION
With the increasing demand of energy, natural gas has remained the fastest increasing fossil energy resource in the world recently. Natural gas is a clean fossil fuel which is widely used and can reduce the greenhouse emissions.1 2. The LNG storage tank is the key component in the LNG industry chain which has a specialized type tank used for the storage of liquefied natural gas (LNG). The common characteristics of LNG storage tanks are the ability to store LNG at the very low temperature of -160 °C. LNG storage tanks have double containers, where the inner container contains LNG and the outer container contains insulation materials. The most common tank type is the full containment tank. Tanks vary greatly in size, depending on usage. HZC has now developed a 200,000 m³ above ground tank for the Jiangsu LNG Receiving Terminal, which is the maximum full containment tank in china and in commissioning in 2016. LNG storage tank shall be dried and purged with nitrogen to ensure that the moisture dew point and oxygen content in the gas space below the specified figures during commissioning.3 4. The imperfect theoretical calculation method causes obstacle to the calculation of the drying and purging medium, and leads to inaccurately estimate the amount of medium. In order to estimate accurately the nitrogen consumption for drying and purging, dynamic model is used to simulate to 200,000 m³ LNG storage tank drying and purging process via HYSYS Dynamic. Dynamic simulation has been used widely as a tool for studying and training in the oil and gas industry.5 6. Simulation models of water dew point and oxygen content are built, the corresponding results are compared and verified with the practical case in the LNG storage tank construction site.

OBJECTIVES
In this study, a dynamic model of drying and purging process for large-scale LNG storage tank was developed to investigate the dynamic behaviors. The drying and purging area of storage tank are divided to A zone, B zone and C zone according to the structure and drying sequence of tank, showed in Fig.1. The specific figures of drying and purging for the practical engineering project are shown in Table 1.

![Fig. 1 Gas phase space zoning schematic](image)

Table 1: Specific figures of drying and purging process of LNG storage tank

<table>
<thead>
<tr>
<th>Zone</th>
<th>Dew point</th>
<th>Oxygen Content</th>
</tr>
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<tbody>
<tr>
<td>A zone</td>
<td>-20 °C</td>
<td>2%</td>
</tr>
<tr>
<td>B zone</td>
<td>-10 °C</td>
<td>2%</td>
</tr>
<tr>
<td>C zone</td>
<td>No Requirement</td>
<td>2%</td>
</tr>
</tbody>
</table>

![Fig. 2 Simulation modeling schematic of LNG storage tank purging](image)

CONCLUSIONS
In this study, the dynamic simulation results were compared with nitrogen practical consumption to verify the accuracy of dynamic model. The dynamic simulation are concluded as follows:

1. The dynamic simulation can be used to predict the consumption of large-scale LNG storage tank drying and purging process.
2. The dew point and oxygen content decrease with the increase of nitrogen drying and purging time in zone A. The variation trend of oxygen content is approximated to an exponential function curve and that of dew point is approximated to a linear function.
3. It is found that the oxygen content is easier to meet the target requirements than the dew point in zone A and B, so the main factor restricting the drying and purging time and nitrogen consumption of LNG storage tank is the requirement of the dew point.
4. The total nitrogen consumption is about 1388 t for 200,000 m³ LNG storage tank, which is within 5% deviation of nitrogen practical consumption. The comparison showed good match between dynamic simulation and practical engineering case.

REFERENCE

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