



Investigation of interaction between sea water and crude oil in open ended storage tanks using boundary element method

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Abstract

Underwater oil tanks are commonly used in marine industries, but open ended storage tanks are new and have some advantages. In these devices interaction between sea water and crude oil is very important due to their oil pollution risk. In this study, boundary element method was used to model sea wave propagation on a hemisphere shape under water tank and oil-water common surface oscillation in the tank. Also, kinematic and dynamic boundary conditions of free surface and common surface of oil and water were discretized by Finite difference method. The wave specifications and water depths, which were entered in numerical model, were extracted from Geographic and climatic profiles of Abuzar oil field region in Persian Gulf. The results show an acceptable accordance with other researches. Also, the results illustrated that, using open ended storage tanks near our offshore platforms has not any problem and it can be a good proposal for oil storing by considering their advantages.

Introduction

Oil reservoirs are usually built in land. If these reservoirs are built in bottom of sea, designing and manufacturing will be complicated and the costs will be expensive. But these items could be simpler with lower cost by opening the end of reservoir in bottom of the sea (removing hydrostatic pressure from the reservoir). If an open ended reservoir in the water fills with oil, the oil will be convict in reservoir and reserved for use. Because, the water is denser than oil and do not allow to oil to diffuse in water.

This reservoir has some advantages. It is safe in the wars, because it is under sea. It is convenient for the ships to charge and discharge oil far from the shore. It could be place near offshore platforms. Therefore, it is not necessary long risers for oil transport.

The effects of water waves on this structure and mixing of oil and water are key points in designing of this tank.

Some researchers have been focused on OEST and invented some types of these tanks. (eg, [1], [2], [3]). However, hydrodynamic analysis in this structure by numerical methods has been not studied yet.

In this research, BEM method has been used for calculating wave effect on water oil interface for preventing oil water mixing in the sea. Wave specifications and bathymetry of a zone around Abuzar oil field in Persian Gulf was selected as a case study [4].

Open ended storage tanks

This structure is placed on the sea bottom and sea water could be entered in it. It could reserve oil without mixing water. Fig. 1 shows an OEST, schematically.[2]