A Comparative Analysis of Various Methods of Gas, Crude Oil and Oil Derivatives Transportation

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ABSTRACT

This paper contains a comparative analysis of the various methods used for gas, crude oil and oil gaseous and liquid derivatives. The analysis is made in terms of quality, efficiency and safety criteria. Historical and statistical data is provided in order to support the conclusions of the paper: transportation via pipeline is the most efficient and safe method for the transportation of such products.

Keywords: Monitoring, Oil, Petroleum Products, Pipeline, Transportation

INTRODUCTION

Although the transport of oil and gas can be made in other ways (by road, by railway or by water, with oil tanker) pipeline transportation is currently the most used method. This paper highlights the advantages of pipeline transportation compared to other modes of transport. There are also presented a brief history, current stage, dynamics and trends in the transportation of crude oil, gas and petroleum products through pipelines. Finally, there are presented tasks and risks of the transportation through pipelines, in terms of attempts to satisfy the three objectives of a technological process: quality, efficiency and security.

DIFFERENT METHODS FOR OIL AND GAS TRANSPORTATION

Modalities currently used to transport oil, gases and petroleum products are: transportation by road, by railway, by water and through pipelines. By analyzing the advantages and disadvantages
of each mode of transport it can be shown that pipelines are the most efficient and safest way of transportation.

For road transportation, tanks of low capacity are used for transporting small quantities of petroleum products on relatively short distances. The cost of transport is high and there is the disadvantage of the route imposed by the existing road network.

Railway transportation also leads to higher costs, ensuring supply of small quantities of petroleum products over long distances, but with a required route of the railway network. This modality of transport has the disadvantage that the products are downloaded by ramps sidings, after which other means of transport must ensure delivery to the customer.

For transportation by water (river or sea) specialized ships called oil tankers are used. Products are loaded in special sections of the ship called tanks. Large tankers are carrying oil from extraction site to the refinery, and smaller tankers transport petroleum products from refineries to distribution networks. The capacity of an oil tanker is expressed in DWT (deadweight tons) - maximum load capacity of the ship, representing the reserves of fuel, oil and water, supplies and payload (including crew and passengers with their luggage). From the first transport ship named Elizabeth Watts, which in 1861 crossed the Atlantic Ocean carrying 1,300 barrels (206,683 l) of oil, petroleum-ships have experienced a continuous development. Currently there are being built ships having increased load capacities (supertankers), exceeding 400,000 DWT. The largest oil tankers currently used are TI Europe (MarineTraffic.com, 2014) and TI Oceania (MarineTraffic.com, 2014), each with a capacity of 441,500 DWT, length 380 m, can carry 3,166,353 barrels (503,409,900 l) oil.

Shipping is considered to be the second method, after transport through pipelines, in terms of efficiency. Worldwide, tankers annually transport approximately 2 billion barrels ($3.2 \times 10^{11}$ l) and the transport costs only $0.02$ per gallon (1 gallon = 3.785 l). Water transportation of petroleum products has some disadvantages. Thus, it can’t be used between points located within the continental masses, and marine transport of petroleum products have been characterized so far by a number of incidents which have ecological consequences of large proportions.

Regarding transportation through pipelines, it was proved that this method of transport is the most efficient in terms of cost, but also the safest, in terms of the number of incidents occurring in the transport process.

The main advantages of pipeline transportation are the following (Turuț, Boicu, & Spirea, 1978; Soare, 2002):

- Continuous operation;
- Low cost of operation;
- Large possibilities for automation;
- Because many of the pipes are underground, away from most of the factors that could damage, involves a simple and convenient operation;
- There can be successively pumped different liquids through pipelines, pumping thus bringing numerous economic advantages;
- An efficient system for monitoring the transportation process can largely eliminate loss products;
- For pipeline transportation all energy consumed is used only for handling the product;
- Of all means of transport, the pipeline is the least polluting.

Also, there have been identified disadvantages, such as:

- Corrosion of the pipes, which may be of different types: electrochemical corrosion, chemical corrosion, the corrosion induced by soil, microbial corrosion, the corrosion caused by mechanical stresses, corrosion caused by erosion;
- Loss of products due to fissures by accident or due to vandalism. Big length of the pipe leads to difficulties in measuring immedi-
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