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UTILIZATION OF WASTE OIL-DERIVATIVES

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ABSTRACT
The results and the opportunities offered by the method of liquid fuels emulsification with water or effluents containing oil derivatives with the objective of utilization of waste oil products from Burgas refinery are presented. Problems are outlined and experimental results from masout emulsification with waste products inside a burning installation located at the refinery petrol harbor are pointed out. An installation encompassing system for waste escavation from the lagoons and a system for rendering this product up to the conditions (stipulating suspended solids) enabling their use in burners is proposed.

INTRODUCTION

A definite amount of waste products, mostly liquid, are inevitably present during crude oil processing at the Lukoil-Neftochim oil refinery in Burgas. In order to contain these wastes, waste lagoons are erected at the refinery site which store some more than several thousand cubic meters liquid wastes. They contain the whole spectra of liquid oil derivatives, paraffin, plastics and all varieties of solid wastes together with water. Water is due to the constant influx of process effluents containing liquid pollutants and dispersed solids and also because of rainfalls since the lagoons are located under open air. An installation for waste burning exists, however such is its capacity that it could not handle the whole amount and moreover the oil contaminated effluents are a serious environmental problem. Recently a project bid was announced by the refinery with objective of complex solution of this mounting problem.

Some 10 years ago, the “Vibroacoustical intensification of technological processes” laboratory at the University of Mining and Geology in close cooperation with “Thermochim Engineering” Co. from Veliko Tarnovo has placed an attempt for solving the above problem based on our past experience which the lab posses in direction of emulsification water-liquid fuels, i.e. the so called water-burnable emulsions. Masout emulsification by means of water addition up to 10 – 15 % is leading to: superior burning process; reduction in the overall amount of soot generation; reduction of nitrous and sulphurous oxides emissions and under certain circumstances is economizing fuel. This technology adapted to the specific conditions of the refinery, could enable a certain amount of liquid waste, freed form solids, to be added to the masout produced by the refinery. Such a masout mixture could be gladly used for local needs of the refinery, i.e. to be burnt in the local Thermal Station or could be offered to other clients with similar demands.

PREPARATION OF WASTE PRODUCTS FOR BURNING

In order to accomplish waste products burning process, one has to remove the solid phase, i.e. all solid waste components having maximal size up to 0,063 mm, which is a compulsory requirement in order to guarantee normal functioning for the pumps and the burners. For the initial experimental set-up a definite quantity from the waste product needs to be prepared and further on this amount should be experimentally burned in the chamber in order to verify the correct mixing ratio of the product.

The experimental sequence of the proposed technology has involved taking sample in amount of about 300 L which was subjected to purification. The first “rough purification” step has involved screening the material on 10 and 1 mm sieves which enables significant part of the rough sold contaminants to be removed. Following the “rougher” stage the sample was further subjected to filtration with 0.3 mm openings, the resulting filtrate being fed to a tank – auto cistern. The liquid fraction thus obtained carries a definite amount of burnable fractions on the basis of the initial oil wastes – water and solid phase with size range – 0.3 mm. The concentration of burnable fractions depends solely on the spot where the sample is taken, i.e. the lagoon type and the sampling depth. Going through the vertical profile of the lagoon, one could notice that the content of the various products is changing: the oil fractions which are lighter than the water are met bot on the surface and on certain depth; going further down, the concentration of heaviest burnable fractions and paraffin, as well as layers of roughly emulsified in water oil derivatives, water itself and solid dense wastes is increased. In order for the liquid fraction purified from suspended solids to be subjected to burning, a specific regime which eliminates or masks the water presence effect need to be maintained. The emulsification takes place in a special installation which design offers the possibility for the additional liquid phase supplied and mixed with masout to be dispersed in micron sized drops. If pure water is added, this quantity could be 10 to 15 % as noted earlier in the text, which mode offers certain advantages; when contaminated effluents are used this quantity could be several times higher depending on the concentration of burnable fractions and upon the operating mode of the installation – whether it is used for clean-up purposes only or a definite energy effects are pursuit. When such types of fuel wastes coming from refinery lagoons are burnt, an account on their water content should be taken and knowing this figure the additional water quantity should be estimated. The emulsification installation (shown at Figure1) which has possibility for supplying different quantity from the additional liquid to be emulsified, is dispersing the liquid by means of vibroacoustical autopulsating emulgator (Metodiev, Stoev et al. 1987, Metodiev 1994) which hydrodynamical parameters enable the liquid to be vortex cut onto fine drops.

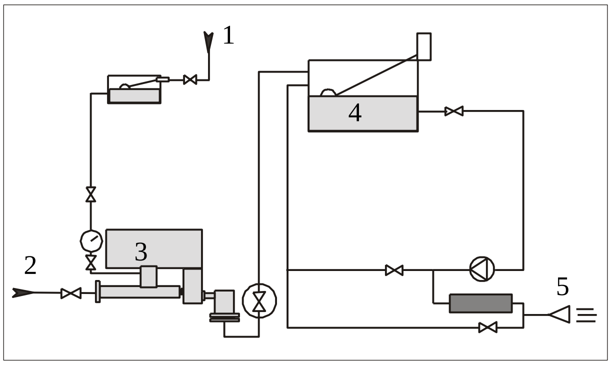

Figure 1. Installation for emulsification.
1-waste products, 2-masout 3- emulsification system, 4-daily tank, 5-burner

The drops produced are then homogenized via the autopulsating vibration impact resulting from the valve which vibrates as a result from the pulsating pressure. The combination of several type of impacts enables effective stream dispersion to occur and the possibility for using of nozzle with relatively large openings generating fine emulsion drops at large throughput of passing media.

In an attempt to study the possibility for burning of the liquid fraction obtained by the above described method, the boiler installation existing at the refinery harbor was used. The waste product leaving the cistern was mixed with pure masout by means of emulsification installation working in two modes – 15 and 20 % waste product composition. The ready-make emulsion was stored in an intermediate tank belonging to the boiler installation. Steady-state burning regime was observed when emulsified fuel was fed meaning that the boiler could be run in a continuous mode for three hours securing the required amount of energy until finishing the whole amount of emulsion prepared for the batch. This experiment has proved the possibility for utilization of oily waste waters by means of their burning in a boiler system, without perturbations in its operation regime.

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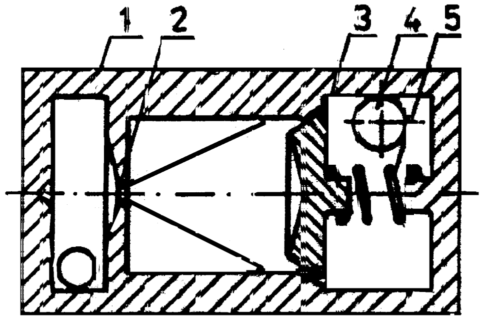

Figure 2. An emulsifier
1-chamber, 2-nozzle, 3-valve, 4-exit, 5-spring

In order to realize the suggested method parallel to burning of a definite amount of emulsion, few principal issues regarding waste products escavation and processing were needed to be addressed. The mode of products transportation from the lagoons to the installation needs to secure relatively constant parameters for the different fraction in time, since these are vital for the additional quantity of waste which the pure masout can accommodate. Moreover, the rejection of the rough solid wastes needs to secure their storage without generation of additional liquid waste.

THE CONDITIONING INTSALLATION

In order to realize the process for waste utilization the flowsheet shown at Figure 3 was suggested. The escavation of the wastes from the lagoons was accomplished by means of pump installed on a floating platform equipped with suction piping with definite length (close to the surface) which enables material suction to be maintained at a constant depth. A preventive screen was mounted around the suction pipe, which prevents larger lumps to enter the piping which could eventually block the pump. A membrane type pump needs to be used due to the need for transportation of both solid and liquid products. The floating platform could be situated close to the shore and there is no need of frequent reallocation of the platform owing to the fact that the wastes are sufficiently mobile. Rough wastes rejection is done via conveyor press having perforated body with 5 mm openings.

The press is used to compress solid wastes down to liquid free products. This action is controlled by means of spring fixation at the bottom cover. The rejected liquid phase passes either through the arch screen having 1 mm openings or via the vibration screen having similar openings. The arch screen is more easy to maintain, however the coarse product has higher moisture content in comparison with the same product from the vibration screen. The solid products rejected depending on their liquid phase composition could be either burnt or additionally pressed further. The liquid phase is directed towards filtering system, arranged in several successive steps securing its decontamination up to 0,063 mm. Each cleaning stage involves several filters which are automatically switched when pressure increases up to a predetermined value due to their over filling with solids.

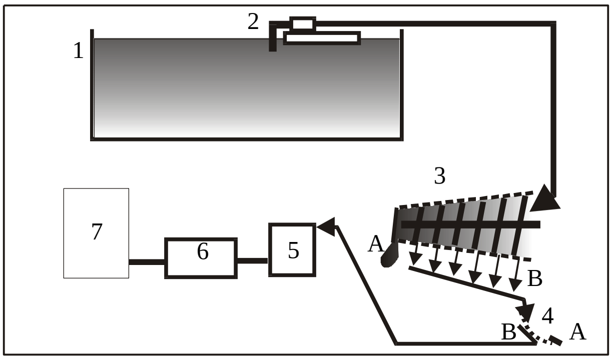

Figure 3. Conditioning installation flowsheet
1-lagoon, 2-floating platform with pump, 3- conveyor press, 4-arch screen, 5- filters, 6-emulsification system, 7-reservoir

This occurs at point which is experimentally estimated during installation adjustment. The percentage of contaminated effluent is determined upon the burnable fractions content. This percentage is higher at the beginning of pumping process, when pumping is done at levels closer to the surface and it starts to drop gradually when pumping area is moved towards the deeper levels of the lagoon when water predominates.

The realization of the suggested method for oil derived wastes utilization will eliminate significant part of them and the costs associated with their treatment will be entirely counterbalanced by the profits anticipated with their burning. Due to the large amount of the stated wastes, the masout thus produced apart for covering local needs, could be offered to outside clients at reduced prices. Besides, masout emulsification is expecting to has a favorable effect upon burning process inside boiler chambers, since at normal temperatures due to the increased viscosity no water lamination is evident. This expectation is supported by the results coming from the long lasting experience which various industrial establishments in the country have in using water-emulsified masout. The fuel emulsions thus treated have been proved stable in a long time period.

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