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METHOD OF CALIBRATE IN DIFFERENT CONFIGURATION TANKS

Mazahir Isayev[1], Shaig Babakhanov[2], Shakir Musayev[3]

Institute of Cybernetics of ANAS, Baku, Azerbaijan
[1]*mezahir@bk.ru*, [3]*shakir@azpetrol.com*

Increasing interest to the hydrocarbon resources of all the nations over the entire world makes actual creating advanced intellectual methods of information-metering and control systems in the field of oil and natural gases operating, receiving, storing and delivering processes.

To carry out an operative and precise commercial record of an obtained liquid fuel in gathering in terminal and delivering to customers the tanks' technical equipping and metrological providing are required. So, rapidly developing rate of information technologies made updating of control-metering devices in terminals from intellectual viewpoint.

Alongside with applying of new intellectual devices there is urgent need for redeveloping of different size and configuration tanks' individual leveling tables (ILT) by more precise and effective methods. Individual leveling tables being main normative document and having important magnitude in commercial recording of a product, up today were realized, generally, by geometric method, in other words, by hand. To understand how difficult these geometric records were, it's more than enough to pay attention to the existing standards (GOSTs) [1, 2]. More labor-intensive and time-taking geometric measuring, providing all leveling operations by hand, numerous computations, using corrections and coefficients etc. proves inefficiency and outdated of this method.

At present article, on basis of up-to-date electron facilities-intellectual control-metering and controlling apparatus with intellectual approach, the problem of creating of one more advanced leveling system are considered.

In exporting of liquid fuel to world market the main categories of existing technological process chart includes the oil and oil product pipelines, pumping stations and terminals. Terminals that store liquid fuel represent the different configuration and big size of oil and oil product tanks' farm. It was established that the tanks constructed in the same type and "the same size" are significantly differ each from other. Therefore, during fillup a tank with oil their capacity and deformation are differ. Thereby, in case of using geometric methods it is impossible to prepare individual leveling tables with great accuracy and next-repeated new leveling process requires a lot of effort and financial expenditures.

As a result of analyses for tanks leveling absolutely new approach-based on hydrostatic measuring method [3, 4] and by the use of model measuring tank automated new leveling system and method has been developed.

The generalized structure of the system is shown in the figure 1.

The developed unit based on microprocessor control principle allows metering liquid fuel in the model tank by the piezometric method, then liquid is delivered into the tank which leveling should be determined and at the same time the liquid volume in this tank is precisely measured by hydrostatic method. This operation is lasted up to the fillup of the tank and for the every measuring liquid layer individual leveling table is composed. Thus, all metering operation results are recorded in the computer storage.

Functioning of the system is carried out by means of the controller creating information contact between personal computer and metering-control devices.

The system was provided by the intellectual operations allowing the processing of the information obtained from the sensors with high accuracy, increasing of the metering by the algorithm-test method, updating of the database, making operative decisions etc.

The hydrostatic pressure created by the liquid column in tanks is determined as [2]:

$$m = \frac{(p_1 - p_2)S_{av.}}{g}, \tag{1}$$

where p_1 and p_2 are, relatively, hydrostatic pressures created at the two different heights of the tank; S_{av} is average value of the cross-sectional area of the tank filled by the liquid up; g is acceleration of gravity. Using this model liquid is pumped in portions (in "standard" mass) into the tank until it filling and with adding of every portion liquid column is measured, then the appropriate masses of liquid is defined by the expression (1).

In metering operations the presure differential measuring accuracy is determined owing to the precise measuring of the pressures p_1 and p_2.

The hydrostatic pressure created by the first liquid column in the tank at the first metering operation is $p_1^0 - p_g$, the hydrostatic pressure created by the second liquid column in the tank is $p_2^0 - p_g$ and at least, the hydrostatic pressure created by the $n-th$ liquid column in the tank will be $p_n^0 - p_g$. If differential measurements are provided every time the results will be as

$$\begin{aligned} p_1 &= p_1^0 - p_g, \\ p_2 &= p_2^0 - p_g, \\ p_n &= p_n^0 - p_g, \end{aligned} \tag{2}$$

where $p_1, p_2, ..., p_n$ the pressures from the first up to the $n-th$ liquid columns; p_g is the gas phase pressure over the liquid surface in tank.

Liquid columns mass formula in general view is expressed as

$$\begin{aligned} m_1 &= \frac{(p_1^0 - p_q)S_{or.1}}{g}, \\ m_2 &= \frac{(p_2^0 - p_q)S_{or.2}}{g}, \\ &..... \\ m_n &= \frac{(p_n^0 - p_q)S_{or.n}}{g}. \end{aligned} \tag{3}$$

It is clear that with increasing the liquid column height the value of the hydrostatic pressure is increased and in accordance with the pressure to the tank's walls is increased. With increasing the liquid column height the tank's walls are stretched and its initial form is changed. This tank's form deformation formula (mathematical model) precise defining becomes substantially difficult and so, it is impossible to control tank's geometrical form changing. Therefore, the problem will be decided, exactly, by the method suggested at present article and the system created by us. The liquid volume that adequate to the tank's current geometrical form is determined owing to the new leveling table. At this time all equipment placed into the tank, and the roughness of the equipment is taken account. If all tank's volume is filled up, the liquid amount is determined by measuring hydrostatic pressure with high accuracy.

It should be noted that in spite of the equality of the mass of every liquid layer filled the tank, the height of every liquid layer will be different in its magnitude, and the tank's leveling steps will have the different values. Thus and so, to determine the tank's leveling it was

suggested to compose special tables expressing the relationship between liquid columns hydrostatic pressures and their appropriate masses, but not according the steady liquid column heights.

Owing to the temperature and pressures differential high accuracy measurement it is possible to define the oil products other technological parameters and providing high precision control-metering and control operations.

The task investigated was tested by means of computer imitation modeling in series tanks and obtained metering errors distribution curve are shown in the figure 2.

As it is shown in the picture in both processes the error does not go beyond the lower and upper ranges and is placed inside of acceptable framework.

Applying of such kind modeling both emptying and fiillup of tank processes it is possible to control all liquid fuel parameters. Values accessible choosing against the background allows to get individual leveling tables for all arbitrary size and form tanks as its required.

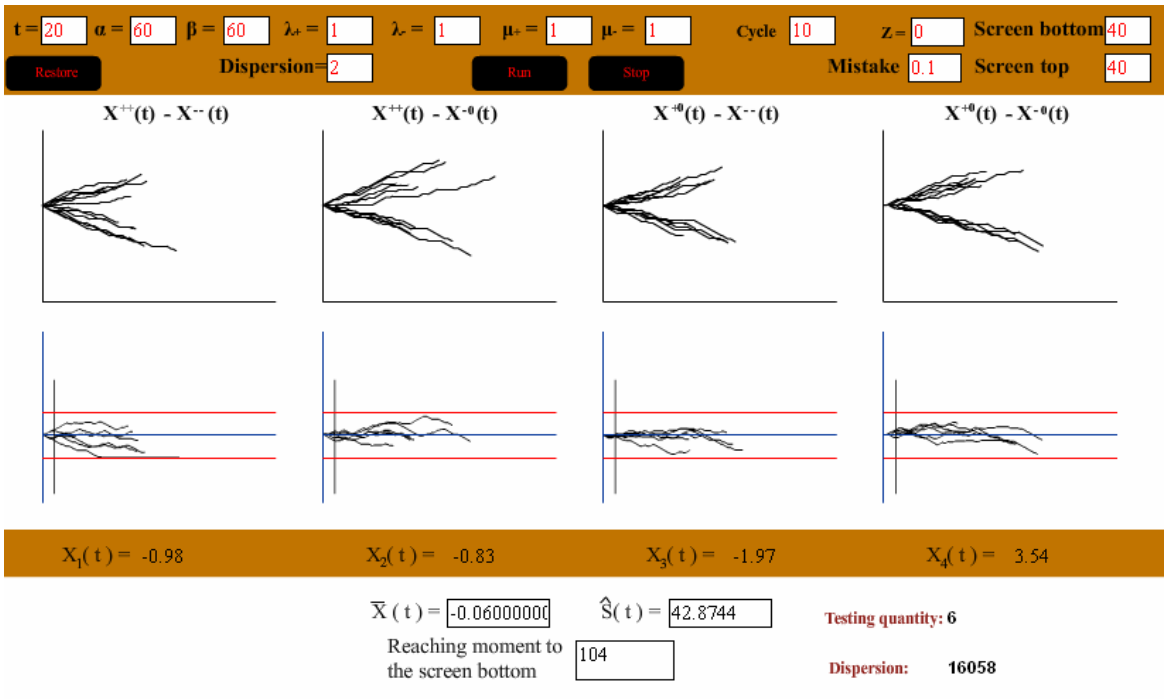

Figure 2. Metering errors distribution diagram during tank's leveling process at its emptying and fillup

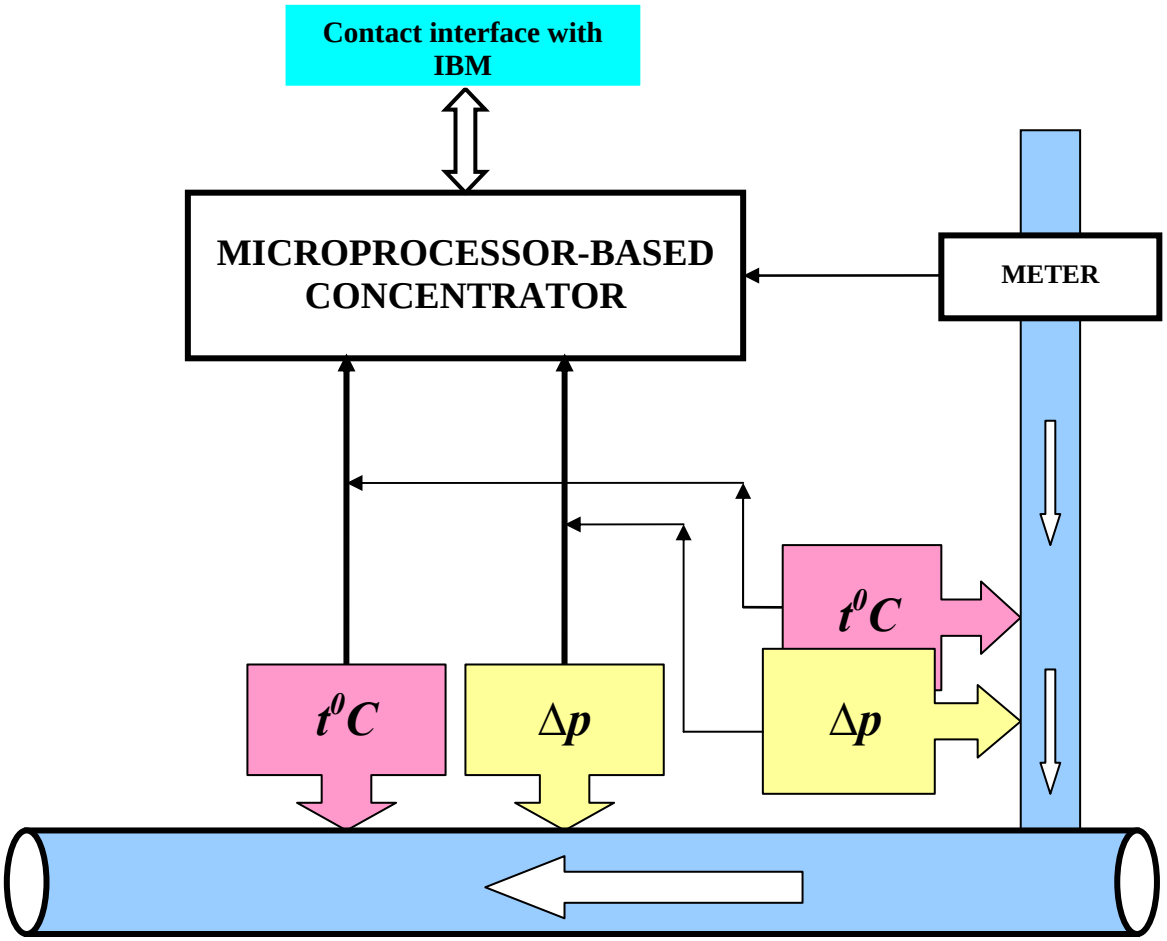

Figure 1. Structure chart of the system

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