PRINCIPLES OF BUILDING OF INTELLECTUAL IMS FOR OIL AND OIL PRODUCTS QUANTITATIVE ACCOUNT

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Azerbaijan Oil companies represent gigantic, geographically distributed multifunctional production-commercial formations. They cover the whole chain of the oil business: exploring and extraction, oil processing and petrochemistry, wholesale and retail production distribution. Old systems built many years ago are operated on enterprises, too. All of them, as a rule, were built step-by-step and they used to solve only particular, current problems on that moment, when they were developed and applied. Often during creation of these systems building principles actual to date such as scalability, flexibility, unification, reliability, openness were not taken into account. It has brought to that information on processes of production is not authentic, or is not full enough, or is absent in general, or is inaccessible for people making decisions, or is available in such form, which does not allow to use modern methods of the complex analysis.

Research and development processes of effective means of oil and oil products (OOP) quantitative account on flow according to mass in different branches of industry are directly related to necessity of mechanization and automatization efficiency increasing.

The standard account unit consists of:

- a measuring line block including, as a rule, 3 lines (the working, reserve and control), which comprise filters, a consumption converter (CC), straight sections before and after CC, stream rectifiers, stop valve, the pressure and the temperature sensors, consuption regulating valves and etc.;
- a quality monitor unit, which includes two by two flow densimeters and viscosimeters, automatic autosamplers and sample storages, the pressure and the temperature sensors, pumps, thermostats, gas pollution alarms and etc.;
- a secondary apparatus and information processing block.

In addition, account and control unit includes a sampling device, stationary turboreciprocating apparatus (or mobile TRA connection is foreseen), free gas content alarm, auxiliary measurement means for densimeters and viscosimeters.

The Modern requirements for means of the account adds up to the following:

- intellectualization - modern field instruments are data servers;
- multifunctionality (the realization of the full engineering decision of all necessary parameters measurement in one point);
- ensuring of the information transfer from field instruments to the main block by means of digital protocols, allowing to send significant information arrays and excluding additional errors, connected with a conversion of controlled parameters and measurement results (MR) transfer;
- ensuring of the acceptance possibility not of separate physical signals from each measuring tool, but to get and process information arrays from intellectual devices;
- a reduction of the production costs;
- a reduction of the costs on transportation, montage, starting-adjustment, technical maintenance and metrological guarantee;
- modules interchangeability; interchangeability of all components of the system;
- increasing of mean time to failure$
- increasing of recovery time in case of refusal;
- production and ecological safety.

The new generation automatized account unit which is founded on using Coriolis acceleration flowmeters of the Micro Motion company and control systems of the Delta V (Fisher Rosemount) type can serve as example of the similar system of the OOP amount measurement, answering to world tendency in the field of instrument engineering and automatization and serving the requirements presented to goods-commercial operations.

We shall consider the primary converters manufactured in our country and in the near abroad.

The flow liquid densimeter AIP-2M (Azerb. SPA "Neftegazavtomat") contains the primary converter, representing vibratory-frequency converter, informative parameter of the output signal of which is pulse period. Measurement results correction and density calculation on the following algorithm is made in the secondary device:

$$\rho_T = \left(\frac{N}{K_1}\right)^2 - K_2$$

where, K_1, K_2 – are constants; N – is the conversion result (the pulse count), got in the measurement cycle of the output pulses period of a vibratory density converter.

The constant K_1 is calculated on the following formula:

$$K_1 = 64 f_T T_0 \sqrt{K}$$

where f – is a quartz generator frequency, Hz; T_0 – is initial value of the input pulses period of the vibratory density converter, K – is density conversion coefficient of the vibratory converter, m^3/kq. The constant K_2 is calculated on the following formula:

$$K_2 = \frac{1}{K}$$

Further with the help of platinum thermometer (for example, TCP50 or TCP100) the product temperature t is defined in the instrument. An algorithmic correction of density MR is produced by quadratic after temperature definition:

$$\rho_1 = \rho_T - a_1(t-20) - a_2(t-20)^2$$

where a_1, a_2 – are temperature coefficients of the vibratory density converter.

The sensor of the "Saphire" type with current output unified signal 4-20 mA is broadly used as a pressure sensor. After determination of the pressure p, an algorithmic correction of density MR is produced by quadratic which parameter is a pressure P:

$$\rho = \rho_1 - b_1 P - b_2 P^2$$

where b1, b2 are coefficients of pressure sensitivity.

Updated thereby MR has absolute error 1кГ/m3 within the range of product density changing from 650 till 1050 kG/m3. Carried out experiments have shown that maximum relative error of density measurement in given range does not exceed the value 0,16%.

Having sufficient statistics about accuracy features of the density measuring device one may calculate admissible error of the volume ΔV determination. The counters of the Livensk plant of liquid counters (LPLC) are broadly used as counters suitable by such parameters as productivity, diameters of the conditional sections, operating temperature, and products viscosity for carrying out majority types of account operations on oil products ensuring enterprises. According to technical requirements on counters their error forms 0,5% and 0,25%. Seemingly the problem of the effective system of the OOP quantitative account can be solved if admissible error of mass definition satisfies the condition Em<0,4%. It is comparatively simply with using of the corresponding counter of the class 0,25 and the densimeter AIP-2M. However, there are reasons preventing such solving and concluded in following:

- in strong dependency of the counter relative error from affecting factors, first of all, from the consumption and environment viscosity;
- in that issue of counters of the class 0,25 can be sloppy, as they are got by selection of complete production and more or less happy choice of transmission gears blocks. As it is shown by the experimental research, many of the counters in practice did not even keep within class 0,5%.

Besides the specified above converters it is known also turbine consumption measuring devices of the "Nord" type intended for main oil pipelines. The ultrasonic converter "Akustron-3" is of interest, too. These converters have determined feature of the error from consumption dependence. However for its detection, as well as detection of functions of other factors influences it is necessary to conduct research of the factory production samples.

In connection with foregoing the purpose of this article is to research metrological features and error structure of the detachable counters for the reason of detecting the effective ways to their correction and creating on their base the system of the OOP quantitative account on flow according to mass. The liquid pressure measurement directly beside counters is necessary in the events, when compressibility of oil products is required to be taken into account. In the events when there is no such need, corresponding pressure sensors can be no set.

In the general case, it is necessary to organize three information channels from the location place of the density converter or the counter to secondary equipment:

- The Number-pulsed (frequency) channel;
- The temperature measurement channel;
- The pressure measurement channel.

Herewith admissible length of communication lines depends on an object distribution and can reach 500 m.

One densimeter and up to four counters must enter to the main variant (the basic kit) of the system, however there is the principle possibility to increase the number of primary converters. Parallel installation of several counters of the type ВЖУ-100 or ВЖУ-150 is necessary for the measurement of OOP amount released (received) by pipes with a big diameter (on great consumptions). The working pressure of liquid must not exceed 1,6 MPa as working pressure of counters is the same and it satisfies work conditions of many industrial objects.

The Secondary equipment of the system must work in two modes:

1. In the calibration mode;
2. In the operating mode.

In the calibration mode parameters calibration values of the counters and the densimeter enter on each channel.

In the operating mode the withdrawal of values of released (received) mass of OOP is carried out. The type of necessary information and channel, on which indication is carried out is assigned by operator or on interface automatically.

Thus, due to such an approach it is realized an effective control and management of technological process parameters in real time all along the technological process. In its turn it brings to increase of produced production quality.

Conclusion

1. Research and development processes of effective means of oil and oil products (OOP) quantitative account on flow according to mass in different branches of industry are directly related to necessity of mechanization and automatization efficiency increasing.

2. Having sufficient statistics about accuracy features of the density measuring device one may calculate admissible error of the volume determination.
3. It is necessary to organize three information channels from the location place of the density converter or the counter to secondary equipment.
4. Under such approach it is realized an effective control and management of technological process parameters in real time all along the technological process.

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