1.11.6. MAGNETOMETRIC DIAGNOSTICS OF GAS AND OIL PIPELINES

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Every year experts of Energodiagnostika Co. Ltd and Tomsk ETC Co. Ltd carry out a large scope of works on non-destructive testing of operated 720 mm, 1020 mm and 1420 mm pipes.

Inspection is performed using the metal magnetic memory (MMM) method, as well as specialized instruments and scanning devices (SD) with the purpose of rapid pipes sorting by fit, unfit pipes and pipes requiring additional inspection and repairs. The specific feature of the MMM method, which distinguishes it from other NDT methods, is that it detects stress concentration on defects, i.e. it evaluates the degree of their hazard in relation to the damaging development as well as provides the general stress-strain state assessment of the base metal and welded joints of gas and oil pipelines. Additional inspection by other NDT methods (visual examination, UFD, the eddy-current method, wall thickness measurement, hardness measurement) is carried out on individual pipes, where stress concentration zones (SCZs) with developing defects are detected by the magnetic anomalies using the MMM method in the quick control mode.

According to the "Temporary instruction on reutilization of pipes during the overhaul of the linear portion of trunk gas pipelines", approved by "Gazprom" JSC on 08.07.2005, the magnetic method based on the metal magnetic memory effect is used on the initiative of "Gazprom Transgaz Tomsk" JSC as a preliminary inspection of pipes and pipe sections. It should be noted here that at the preliminary stage the inspection of pipes is performed using special scanning devices without the removal of insulation.

At present Energodiagnostika Co. Ltd. manufactures three types of SD:

– with full coverage of the entire pipe perimeter and with the number of the magnetic field measuring channels from 24 to 32;

– covering half-perimeter of the pipe (up to 24 measurement channels);

– with partial coverage of the pipes for the perimeter length of 300 – 400 mm (12 measurement channels).

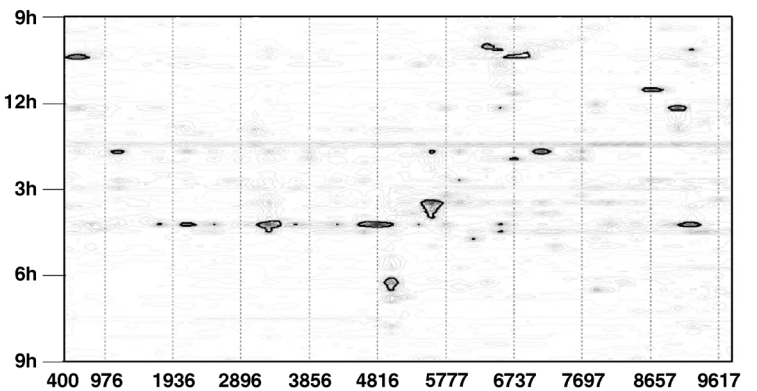

Fig. 1. Distribution of defects and SCZs with maximum values of the H_p field gradient (dH_p / dx) on the scanning of the pipe # 7321 (∅1020 × 12 mm)

During the inspection of gas pipelines using the SD with full pipe coverage the average speed of inspection is 3 – 5 minutes per one pipe with the length of 10 – 11 m. The most dangerous defects leading to pipes failure are detected in the real time mode directly during the inspection. The inspection results are recorded to the instrument's memory with their further printing out in the form of clock-hour scanning of the pipe, which indicates the coordinates of all the detected defects and stress concentration zones on the external and the internal surfaces (see fig. 1).

At present, based on the more than 20-year experience in the development of the metal magnetic memory method and the tsc-type instruments, energodiagnostika co. Ltd. Actively develops the non-contact magnetometric diagnostics (ncmd) of gas pipelines buried under the soil layer.

NCMD is based on measurement of distortions of the magnetic field of the earth (H_{earth}), conditioned by the variation of the pipe metal's magnetic permeability in the stress concentration zones (SCZs) and in zones of the developing corrosion-fatigue damages. The variation pattern of the field H_{earth} (frequency, amplitude) is conditioned by the pipeline deformation occurring in it due to the effect of a number of factors: residual manufacturing and assembly stresses, working load and self-compensation stresses at temperature fluctuations of the outside air and environment (soil, water, etc.).

Nowadays we manufacture and use during NCMD two types of sensors for measurement of the three components of the magnetic field. One sensor allows measurement of the magnetic field along one generatrix or along the pipe axis and another – simultaneously along three or four generatrices with coverage of the entire diameter of the pipe. Our TSC-type instruments, when used as a set with the specialized sensors, can work both in the scanning mode with the length-counting unit and in the "timer" mode.