

1.13.2. REDUCTION OF OPERATIONAL RISK OF VESSELS AND APPARATUS INTENDED FOR APPLICATION IN TECHNOLOGICAL INSTALLATIONS OF CHEMICAL, PETROCHEMICAL AND OTHER RELATED BRANCHES USING NEW COMBINED NON-DESTRUCTIVE TESTING METHODS AND MEANS

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Analysis of accidents and malfunctions observed during commissioning and operation of multi-tonne installations for ammonia production shows that 10 – 15% (of the total number of accidents) is related with design errors, 14 – 16% – with errors during construction and equipment installation, 56 – 61% – with defects in equipment, machines, reinforcement elements, control and measuring apparatus; and 13 – 15% – with mistakes of maintenance personnel.

Most accidents, fires and explosions (80%) are caused by leaks of flammable gases from various technological equipment.

As a rule, welded joints are the weakest link in vessels, apparatus and capacity equipment (hereinafter referred to as the "Vessels"). These joints must be tested in accordance with GOST 3242 "Welded joints. Quality control methods".

Depending on design pressure, wall temperature and nature of operating medium, vessels are divided into six groups.

Volume of welded joints testing by ultrasound or under radiographic method depends on the group of equipment.

Moreover, weld seams in vessels and apparatus referred to 1 and 3 group must be tested for 100% of their length.

During manufacturing of equipment at machine-building plants, requirements specified in GOST 52620 and other normative documents are met, as a rule.

In the process of operation and during expert examination of industrial safety (IS) and technical diagnostics (TD), part of welded joints and walls of equipment appears to be inaccessible for non-destructive testing.

Therefore, for technical risk optimization, program of examination for specific types of equipment is agreed between the Customer and the Executor in order to provide conclusion on IS expert examination. Special attention in this program is paid to testing of points being "narrow" from the point of view of establishing terms of safe operation.

In number of cases, monitoring of individual equipment types by means of acoustic-emission or other types (methods) of non-destructive testing is recommended.

Statistics shows that hidden defects, i.e. defects not revealed by NDT means and methods applied at the given integrated plant or defects not detected during manufacturing and operation, are one of the main reasons of accidents with vessels and apparatus.

Analysis of metals and alloys in equipment applied in technological installations of chemical, petrochemical, oil-refining and other related branches of industry shows that, in average, up to 50% of vessels and apparatus (hereinafter referred to as the "Vessels") of stainless steels and up to 20% of two-ply steels can be located within the processing chain.

Non-destructive testing methods for said steels differ significantly from testing methods for welded joints, carbon and low-alloyed steels, for example. It refers, first of all, to ultrasonic testing (UST). During IS expert examination, application of radiography is not possible frequently due to the one-side access only to the wall of vessel.

Paper discusses main problems occurring during performance of UST of austenite weld seams and two-ply steels due to considerable attenuation and high level of structural noises caused by scattering of ultrasonic (US) waves in polycrystalline material. In coarse-grain materials inherent to austenite weld seams, these problems are aggravated by deviation of US beam from nominal path and its transformation (splitting), as well as anisotropy of elastic properties of seam grains causing variation of US wave propagation velocity. Therefore, special testing methods and means are applied for production US flaw detection.

Prevention and occupational injuries depends in many aspects on efficiency of safety control system (SCS) at enterprises.

Phenomenon of personnel acquired tolerance to hazard is common one for many industry branches. Experienced workers commit fatal mistakes neglecting either of several key safety rules.

Safety level at major enterprise of oil-and-gas complex is defined by the level of safety control culture (SCC).

In industrially developed countries, five SCC levels are distinguished by increasing of awareness, confidence and responsibility for safety. Lowest of them is called by foreign specialists as “pathological”. It is featured by negligence of management and all employees to safety control measures until somebody is caught in act or suffered in the result of an accident. Much to one’s regret, it is possible to consider that “pathological” SCC level is spread widely at many enterprises of oil-and-gas industry.

Next, “reactive” SCC level means serious attitude to safety matters establishing only following some accidents or occupational injuries occur.

Multiple safety measures are undertaken by the results of investigation of reasons of an occurred event.