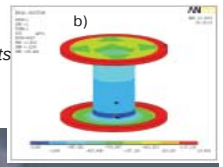
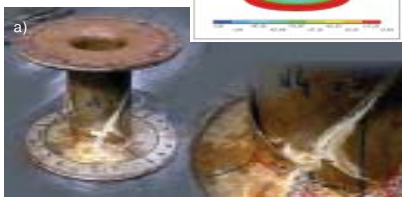
- specify allowable stresses and set PCM coupling bearing capacity;
- define the stress-strained state, rigidity, vibration & damping characteristics for PCM couplings;
- justify the selection of PCM coupling geometrical parameters with respect to technological structural integrity;
- develop the PCM coupling structure and to define the shape and dimensions for their components;
- develop procedures for experimental refinement of VSC structure, from mockup to prototype.

The obtained results have enabled to:

- Define the design conditions to be used for verification of the coupling strength at design based on the analysis of PCM-made VSC operating conditions that ensure the nominal torque M_{nt}=40–400 kN·m transfer at the value of relative displacement for coupled shafts being $\Delta \leq 10$ mm;
- Define allowable stresses and limit state criteria that ensure fatigue strength of PCM-made VSC;
- Develop a procedure defining the stress-strained state, rigidity and vibration damping characteristics for PCM-made VSC using the principles of superposition and elastic - viscoelastic correspondence, as well as ANSYS software package;





Torsion testing of coupling mockup up to failure (fig. a) and results of FEM calculation in ANSYS (fig. b)

Test rig during coupling tests for axial compression and bending. General view

- Plot a mathematical model to calculate geometrical and structural parameters of PCM-made VSC, and to predict their elasticity characteristics with reference to the known material properties of elementary layers;
- Justify the selection of PCM-made VSC geometrical parameters regarding provision of their technological integrity, which made it possible to establish the limit values for relative and absolute wall thickness ensuring absence of lamination in the cylindrical part of the coupling during its heat treatment;
- Develop and build the PCM-made VSC structures providing transfer of the nominal torque M_{nt}=40–400kN·m at the maximum value of relative displacements for coupled shafts 10 mm and full service life being $T_{\Sigma R}=(5–6)10^4$ hours. VSC represents a monolithic elastic element made of glass-reinforced plastic supplied together with metal parts for coupling connection to diesel (reduction gear) and intermediate shaft. Monolithic elastic element is made by contact molding method of glass-reinforced plastic based on glass cloth and epoxy binder.

ACOUSTIC EMISSION METHODOLOGY AND HARDWARE DEVELOPMENT FOR STRUCTURAL STATE DIAGNOSTICS

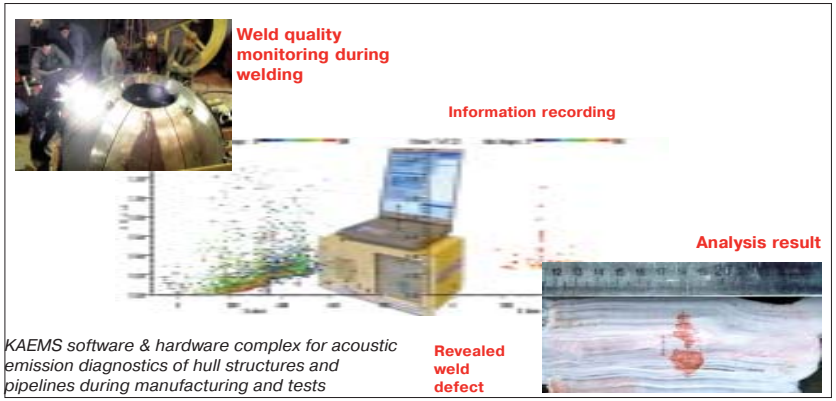
Assurance of large-size structures, pipelines, pressure vessels and process equipment reliability is mostly dependent upon the validity of manufacturing quality assessment and diagnostics of the structural state during tests and service, obtained by available means of non-destructive examination.

To resolve the problem it was required to:

- Study acoustic emission method (AE) application for state assessment of structures under diagnostics at the stage of manufacturing and testing under conditions of manufacturing plant;
- Optimize functional capability range and AE software to solve specific tasks of diagnostics (structural state monitoring during tests, quality control of welds during welding, control of pipeline field welds during testing, etc.);
- Study issues related to selection of comprehensive criteria to assess state of various structures under testing and processes to be monitored using acoustic signals in the real time under shop conditions;
- Elaborate simplified mobile diagnostic AE complexes suitable for application in shop laboratories.

The performed research has enabled to:

- Develop, fabricate and test an updated basic version of multi-channel software/hardware complex of acoustic emission diagnostics (KAEMS) with expanded functional capabilities and improved software and methodological support;
- Confirm feasibility and perspectiveness for development and introduction of simplified procedures for application of AE diagnostics at tests and fabrication of structures;
- Define practical ways for development of comprehensive criteria to assess different structures using acoustic signals in the real time under workshop conditions ;
- Confirm a possibility to develop a family of user-friendly AE hardware complexes, which are suitable for operation under industrial environment;
- Ensure considerable enhancement of quality and service reliability of structures.



KAEMS software & hardware complex for acoustic emission diagnostics of hull structures and pipelines during manufacturing and tests