

Emergency protection of pipelines and equipment: Pressure autostabilizer (PA)

Pressure pulsations, vibrations, hydraulic impacts and different transient processes such as switching on, switching off and switching over of pumping units intensify the mechanism of pipeline degradation and accelerate internal corroding processes. These processes stimulate the accumulation of fatigue characteristics of the material in stress concentration areas and cause emergency breakdowns of the pipeline.

Hydrodynamic processes cause about 70 % of all accidents and breakdowns.

Hydraulic impact is considered to be one of the most dangerous hydrodynamic processes. It may cause emergency breaks in the weakest places of the pipeline system leading to a significant leakage of the transported fluid.

By Vitaly Pestunov, Director-General, TECHPROMARMA LLC

Pressure autostabilizer as an innovative solution

TECHPROMARMA LLC has designed an innovative device – a pressure autostabilizer (PA). It damps hydraulic impacts, pressure surges, noises and acoustic waves in the stream.

According to the design pressure autostabilizers can be produced in two types: pipe type (from 6 to 100 mm in diameter) and chamber type (from 100 mm in diameter), with maximal temperature of 500°C and working pressure of up to 25 MPa.



Pipe type.



Chamber type.

Being installed into the pipeline as an insertion, the pressure autostabilizer does not create additional resistance to the pipe flow. The device is suitable for all media and can be used in a wide range of applications, such as: Power industry (Nuclear power plants, Thermal or Hydroelectric power stations, Hydro-power plants), Housing and utilities sector, Oil and Gas industry, Metallurgy and the Chemical industry.

Hydraulic impacts, pressure surges and noises are wave processes, and any wave of pressure hitting the PA is damped by the movable piston in the damping chamber and by the halls of definite form and sizes.

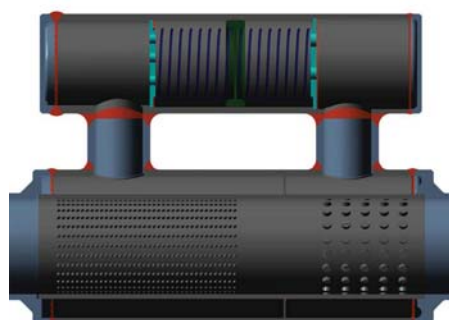
The design and construction of the PA offer many advantages as compared to other similar products. The main advantage of the PA is that it represents a passive system which does not require any energy consumption to maintain

operation. In addition, it lacks any resilient elements and has an unlimited range of damping frequencies.

The principle of pressure autostabilizer operation

In steady-state mode a working fluid such as liquid, gas, or mixture fills up all the chambers from the pipeline. At this time the pressure in all chambers is equal i.e. the same as the pressure in the pipeline. The appearance of the pressure-pulse of any magnitude or polarity at the input of the pressure autostabilizer (generated from hydraulic impact or vibrations) leads to pressure change through perforated holes in the small expansion chamber and in the corresponding part of the damping chamber. As a result of interaction with the piston the hydraulic wave is damped. With some delay the same input pressure pulse has an effect on the piston from opposite side. The pressure pulse effect generated successively from the both sides of the piston leads to energy pulse dissipation caused by hydraulic impact with high efficiency.

The design of the pressure autostabilizer therefore allows to spread out and direct the impulse towards itself. The impulse is used as a resilient element of definite rigidity in the damping chambers instead



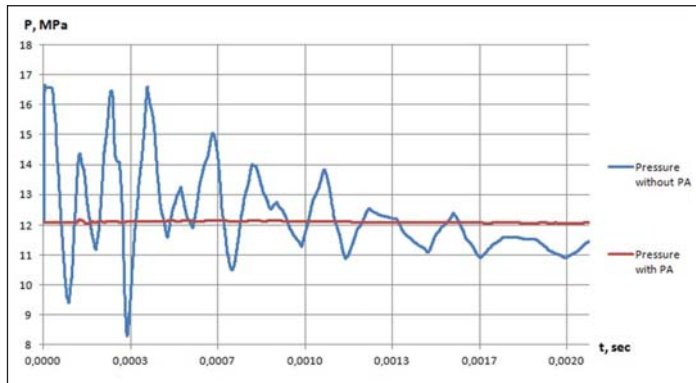
of resilient elements themselves. As a result the pressure autostabilizer does not depend on pressure pulse amplitude and frequency of input pulse. Piston movement is insignificant (0,08-0,1 mm) and it does not cause wear on the springs installed in the pressure stabilizer for piston centering. Hence, the PA does not depend on different values of input impulse. That is, no matter how strong a pressure surge is - almost the same pulse value of opposite sign neutralizes it. The absence of special resilient elements eliminates their aging and limited resource, and provides the device's operation in a wide range of temperatures of working fluids and environments.

PA operates in different working fluids as well as two-phase flows where pulsations and hydraulic impacts are possible.

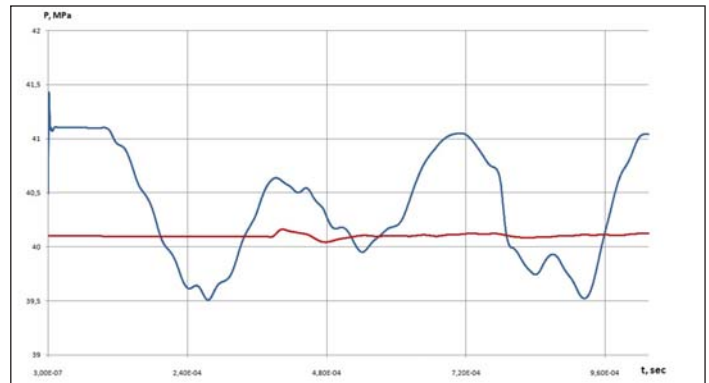
TECHPROMARMA has developed a method of calculation to visually evaluate the damping efficiency of



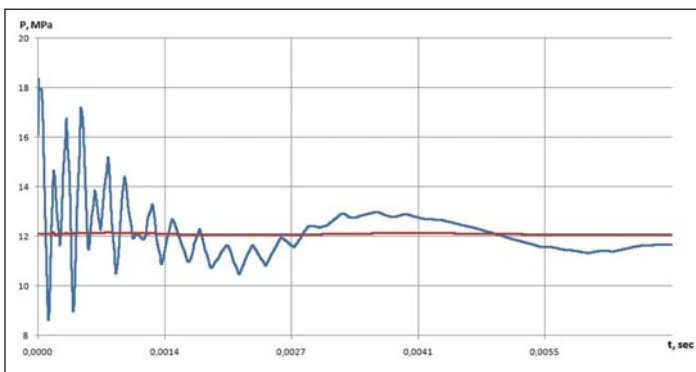
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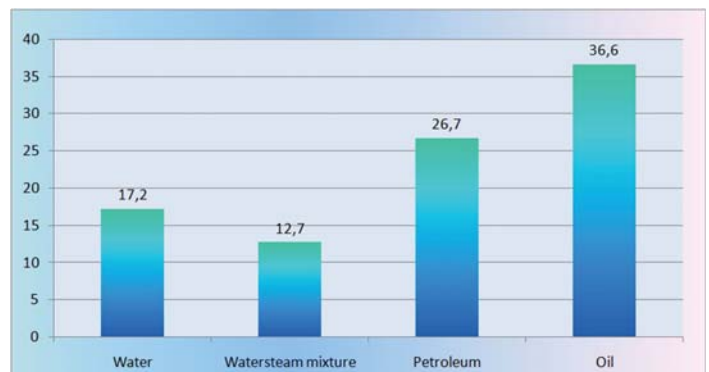
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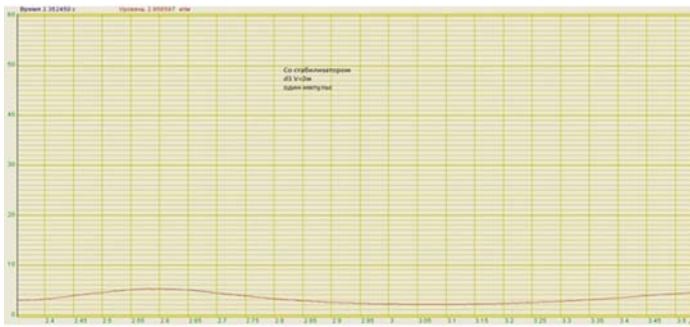


the pressure autostabilizer during the process of hydraulic impact. Calculations were carried out in the finite element software systems for different media and parameters. Each medium has its damping coefficient. Diagrams show some of them. Since hydraulic impulse travels at the speed of sound, the process of surge damping in the stabilizer is instant. The damping time for water remains within

0.0023 sec., while the time of hydraulic impact on the pipeline is about 0.05 sec. Thus, in case of installation, the stabilizer will have time to act before hydraulic impact influence on the pipeline, i.e. the PA does not moderate the effects of the hydraulic impact, rather it eliminates the main reason for it! Pressure autostabilizers were tested on a special stand with modelling of hydraulic impact. The test results fully confirm the

Properties of pressure autostabilizer:

- Instant action (0.003 sec).
- Unlimited range of damping frequencies.
- No loss of working media.
- Environmentally friendly.
- There is no need for service in the operating process.
- Non-volatility.



The diagram on the left shows the hydraulic impact in the pipeline system without the PA in case of emergency closing; the diagram on the right shows the same process with the PA installed.

Application of pressure autostabilizers allows:

- to reduce accident rate of pipelines and its equipment.
- to increase corrosion fatigue life test of the piping systems.
- to prolong the working service of even worn-out pipelines.
- to reduce direct and indirect costs on accident recovery works.
- to reduce operating costs on emergency substitute of pipelines.
- to provide pipeline system repair according to preventive schedule.

mathematical model created and calculated in the finite element software systems.

Tests were conducted on the stand created by "TECHPROMARMA"

LLC with the use of special measuring equipment certified by the Russian Federal

Department for Environmental, Industrial and Nuclear Supervision.

"TECHPROMARMA" LLC continues research and development using advanced technologies for creation innovative safety systems for different branches of industry.

About the author

Vitaly Pestunov, the Director-General of "TECHPROMARMA" LLC, is responsible for research and development of safety and control systems for pipelines and equipment. After graduating from the Bauman Technical University he worked as an engineer in the design-engineering department in the Mission Control Center. Vitaly has over 16 years' experience in the manufacturing and supplying of pipe fittings for nuclear power industry. Pressure autostabilizer is one of his inventions, created for trouble-free operation of pipeline systems. For more information, please visit www.tehpromarma.ru

