

DEVICES FOR DOUBLE IMPLEMENTATION: SUPERCONDUCTING ACCELERATORS AND INDUSTRY

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INTRODUCTION

During ICALEPCS'95 we reported on a number of commercial application for accelerator technologies. We will describe three being implemented in industry.

1 AN ACOUSTIC SENSOR FOR LIGHT GASES

In the gas industry, in mines, and in tunnels four basic principles are currently used for detection of a gas leakage: optical, physical, physiochemical and electrochemical.

Even though it has some advantages, like stable sensitivity, an acoustical principle, based on dependence of the speed of a sound in air on the average molecular weight of a gas mixture, is not used because of zero selectivity and a strong dependence of a sound speed on a temperature. Acoustic principle can be used for detection of a specific gas with a different molecular weight in the air such as helium and methane provide compensation of a temperature dependence of a sound speed.

Such an acoustic sensor was designed at IHEP. The sensor consists of a cylindrical one- half wave resonator with a loud speaker and a microphone in the butt-ends.

A detected gas penetrates into the cylinder by means of simple diffusion through the holes in the middle of a cylindrical surface (zero pressure cross section of the resonator).

A microprocessor sweeps a frequency of a generator to calculates the resonance frequency of the resonator. Two sealed reference resonators with same dimensions are being tested simultaneously. The first is filled with clean dry air. The second is filled with a calibrated mixture of the test gas with air. This provides a means to compensate for temperature and allows self calibration using a precise platine temperature sensor. Interpolation calculations gives the content of the tested gas. A humidity correction is performed using a humidity sensor.

- Obtained parameters:
- volumetric sensitivity of methane0,1%;
- volumetric sensitivity of helium0,05%;
- response time.....5 sec;
- operating temperature range.....-40C to 85 C;
- power consumption.....24 V, 3 W.

2 THE ROTATING SHAFT VIBRATION MEASUREMENT BASED ON FIBER OPTIC SENSOR

The most usable method of vibration control is based on an accelerometer attached to the stator, or bearing, of the machine. This method however doesn't work well for detecting vibration in fast machines with a relatively light rotore. Only the orbit and the position of the rotor center in the bearing gives us enough information to make an accurate judgement of the machine condition. Proximity sensors, usually eddy currant transducers, are attached to the shaft surface for detecting displacement.

While this configuration has many advantages it has some disadvantages: temperature dependence and low reliability under high temperature condition. Also it can't be used for magnet field bearings, also for shaft made of nonmagnetic materials or a shaft that has undergone electrochemical development.

This can be overcome with sensors based on fiber optic technology. They have high sensitivity, broad temperature and frequency range, and are immune to electromagnetic interference.

A system based on the reflect measuring of fiber optic sensors was designed at IHEP for measurement of radial and axial vibrations of a rotor, and speed of rotor revolutions. The system is designed for use in turbines, turbine expanders, electrical motors and electrical generators.

The instrument consists of a set of fiber optic transducer and an electronic module for data processing. The instrument provides a digital indication of vibration and speed and alarm-signal generation. Our fiber optic transducer is 150 mm long. But it can be made longer to remove the electronics from a hazard zone.

Main parameters:

- range of measurement of rotation frequency.....0 to 300.000 rpm;
- linear range of measurement of radial displacement..... 500 mcm;
- measurement error of displacement amplitude.....1 mcm;
- temperature range of sensor.....4K to 650 K;
- explosion proof design.

The delivered application program provides accurate representation of the processes over time. It supplies 2D

and 3D pictures of the rotor motion It reveals resonant frequencies of rotor

oscillations during both acceleration and deceleration. It calculates the number of revolutions from startup to the machine maximum rotation value.

3 A TOOL KIT FOR TESTING UNDERGROUND PIPELINES INSULATION

Decades of experience on maintenance of Russia's petroleum and gas pipelines have demonstrated that the currently used set of testing equipment does not give complete picture of a condition of insulation. The decades old design of a one frequency sinusoide generator and voltmeter does not compensate for differences in electrical properties of soils, for the complexity of the equivalent model of insulation cover, or for industrial interferences.

A new specification for Russia's gas industry has been worked out. The IHEP portable tool kit for an integrated estimation of the condition of underground pipeline insulation coverings has been developed. It is based on measurement on several fixed frequencies, not multiple industrial.

The working frequencies are 3.75Hz, 7.5Hz, 18.75Hz, 187.5Hz, and 937.5 Hz.

Parameters of the frequency generator:

- current up to 1000 mA on a load $4 - 60 \Omega$ with inductance 1 mH;
- AC power supply operating at 50 Hz or battery with recharger;

Parameters of the voltmeter:

- Three measurement ranges of 0 to 10 mV, 0 to 100 mV, or 0 to 1000 mV;
- 1% measurement error;
- suppression of interferences 80 dB (50 Hz) and 60 dB (100 Hz);
- power supply is a battery with recharger.