

THE USE OF NON-CONTACT METHODS TO MEASURE THE RESIDUAL STRESSES IN A WELD AS A MEANS FOR IMPROVING THE SAFETY OF NUCLEAR POWER STATION

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Introduction

A large the number of welds is used at nuclear power plants (NPP), therefore the quality of these welds plays an important role in the safe operation of NPP.

Today there are 2 basic methods to measure the residual stresses, namely contact and non-contact methods. Non-contact methods can be classified as Neutron method, Ultrasonic method, Magnetic method, Synchrotron method and X-ray method. The aim of this article is to compare the two most accurate methods - Magnetic and Ultrasonic ones.

Magnetic method

To measure residual stress (voltage), the object is gradually magnetized and then demagnetized. Hall sensor is used to measure the strength of the demagnetization field. After this, the amplitude of the signal is converted to residual stress (voltage).

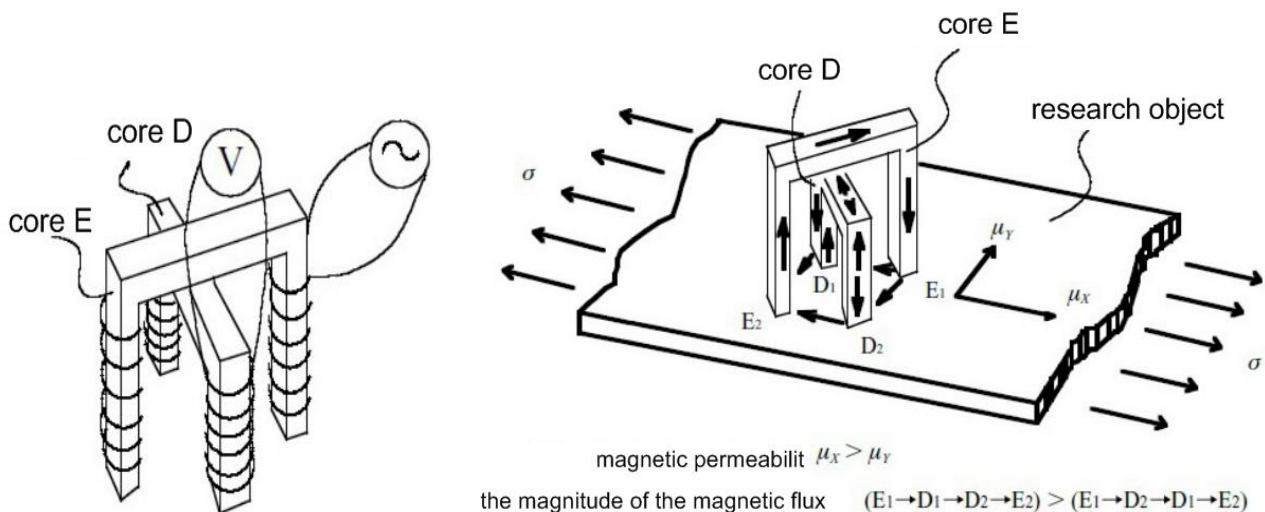


Fig.1. Magnetic method (operating principle)

The benefits of the magnetic method are:

1. high speed of measuring;
2. this method can be used on the working structures.

The major disadvantages of the magnetic method are as following:

1. suitable only for ferromagnetic materials;
2. high labor intensity;
3. high cost.

Ultrasonic method

This method is based on changing parameters propagating waves in a solid. Alternating current passes through a coil pass and generates alternating magnetic field around it producing eddy current in the test object. This current interacts with the

magnetic field of the magnet causing the Lorentz force to create ultrasonic vibrations in the object.

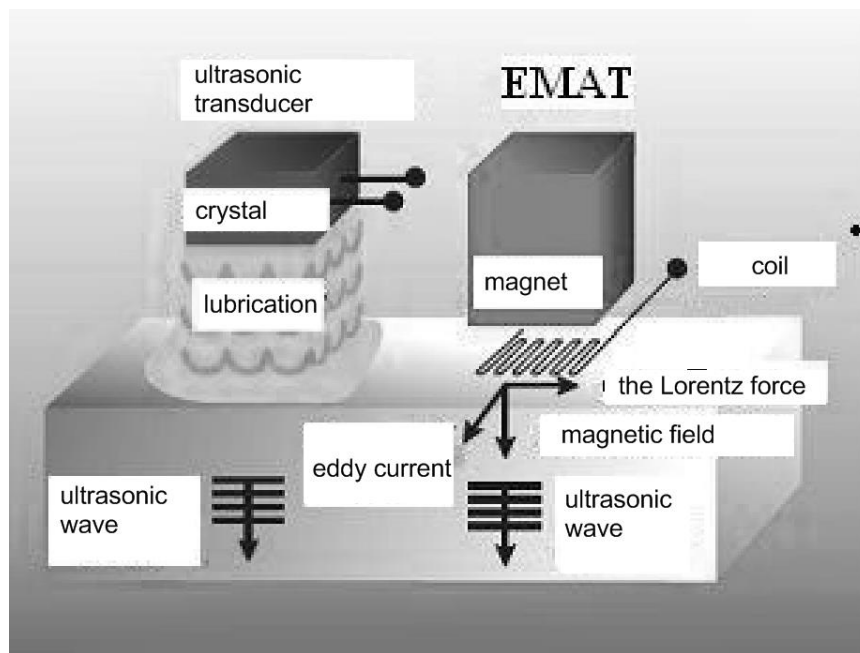


Fig.2 Ultrasonic method (operating principle)

Among the benefits of the ultrasonic method are:

1. high speed of measuring;
2. no material restrictions;
3. can be used on the working structures.

Using these methods on NPP with the help of robots

To explore the seams inside the reactor we need to get inside. But for people get inside reactor is problem. This problem was solved by robots. These robots can go on walls and overcome obstacles such as bolts. The robots have sensors for non-contact research and camera. This technology is used at the Onagava NPP and the Tokohama NPP. Unfortunately, these technology is not used in Russia because of its high cost. Figure 3 shows the test system under the control of the cylindrical part the reactor vessel and under the control of a branch pipe zone.

To sum up, the most effective method is Ultrasonic method



Fig. 4. (the test system of the branch pipe zone)

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HYDROGEN ENERGY

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The paper deals with hydrogen fuel that is zero-emission fuel, which uses electrochemical cells or combustion in internal engines, to power vehicles and electric devices. It is also used in the propulsion of spacecraft and might potentially be mass-produced and commercialized for passenger vehicles and aircraft.

Hydrogen is the simplest element. An atom of hydrogen consists of only one proton and one electron. It's also the most plentiful element in the universe. Despite its simplicity and abundance, hydrogen doesn't occur naturally as a gas on the Earth - it's always combined with other elements. Water, for example, is a combination of hydrogen and oxygen (H₂O).

Hydrogen is high in energy, yet an engine that burns pure hydrogen produces almost no pollution. NASA has been using liquid hydrogen to propel the space shuttle and other rockets into orbit. Hydrogen fuel cells power the shuttle's electrical systems producing pure water that the crew drinks.

A fuel cell combines hydrogen and oxygen to produce electricity, heat, and water. Besides, fuel cells are often compared to batteries. Both convert the energy produced by a chemical reaction into usable electric power. However, the fuel cell will produce electricity as long as fuel (hydrogen) is supplied, never losing its charge.

Fuel cells are a promising technology for use. It can be used as a source of heat and electricity for buildings, and as an electrical power source for electric motors propelling vehicles.

In the future, hydrogen could also join electricity as an important energy carrier. An energy carrier moves and delivers energy in a usable form to consumers. Renewable energy sources, like the sun and wind, can't produce energy all the time. But they could, for example, produce electric energy and hydrogen, which can be stored