УДК 625.7

# TENSION AND HYGROSENSORS USAGE IN MONITORING SYSTEMS FOR ROAD CONSTRUCTIONS

**V. Y. Skrypnik, aspirant,**
**T. V. Skrypnik, Candidate of Engineerings Sciences, Docent,**
**T.A.Marakhovskaya, Candidate of Philology**
**Automobile Highway Engineering Institute of**
**State Higher Educational Establishment**
**«Donetsk National Technical University»**

***Summary***. *The article describes the main types of sensors, which can be used in road construction monitoring systems, and their principles of operation. The analysis of the main types of road construction deformations has been done. The reasonability of the proposed sensors for the timely road construction management was determined.*

***Key-words:*** *monitoring, subgrade, embankment, hygrosensor, pressure and humidity sensors.*

# ВИКОРИСТАННЯ ТЕНЗО- ТА ГІГРОДАТЧИКІВ В СИСТЕМАХ МОНІТОРИНГУ ДОРОЖНЬОЇ КОНСТРУКЦІЇ

**В.Ю. Скрипник, аспірант,**
**Т.В. Скрипник, канд. тех. н., доцент,**
**Т.А.Мараховская, к.філол.н., доцент**
**Автомобільно-дорожній інститут**
**державного вищого навчального закладу**
**« Донецький національний технічний університет»**

***Анотація.*** *В статті розглянуті основні типи датчиків, які можна використовувати в системах моніторингу дорожніх конструкцій, їх принцип дії. Проведено аналіз основних видів деформацій дорожніх конструкцій. Визначена доцільність використання запропонованих видів датчиків, для своєчасного регулювання стану дорожньої конструкції. Визначено напрямки подальшої роботи.*

***Ключові слова:*** *моніторинг, дорожня конструкція, тензодатчик, гігродатчик.*

Changes in conditions and characteristics of a soil embankment, an inner construction, a form and dimensions of subgrade lead to reduction of road operational abilities, a set of defects and deformations.

Subgrade defects and deformations appear as a result of inability of modern subgrade constructions to meet the growth rate of modern load, technological

imperfections, construction errors, poor conditions of road pavements, lack or low efficiency of protective and fixing facilities.

Subgrade defects and deformations lead to the growth of road-traffic accidents, limitation of car speeds or, in rare cases, a full stoppage of traffic during repair works. All these aspects have a great influence on the transportation process and the traffic safety.

For the first time a term "monitoring" was adopted in 1972 in connection with the environment and it was determined as "a repeated observation system over one or more elements of the environment in space and time with the definite aim as provided by the planned project". Later the environmental monitoring theory (environmental monitoring) has been developed in Russia in the works of an academician U.A. Izrael, who determined that monitoring embraces not only collection of information and observation, but forecast, in addition it can serve as a guideline for the environment condition.

The further development of the environmental monitoring theory led to the division of the whole monitoring system into subsystems. One of such subsystems is geological environment monitoring or lithomonitoring.

The main scientific works on the problems of lithomonitoring go back to the second half of the 1980's. One of the important notions used in lithomonitoring is a nature-technical system (NTS), which is a set of engineering constructions and a part of the geological environment in the zone of influence which has operational fixed limits. So, during lithomonitoring the geological environment is observed not as an isolated case but in cooperation with engineering facilities.

The general notion of geological monitoring was given by V.A.Korolev in his book published by Lomonosov Moscow State University (MSU) in 1995. According to this notion geological monitoring is "a system of constant collection, observation, evaluation, forecast and management of the geological environment, or its part, which are carried out according to a planned program to provide optimal ecological conditions for people within the bounds of the concerned "nature-technical system".

This definition shows the principal difference between monitoring and observations which are a part of monitoring.

A.A.Tsernant was the first who proposed in 1990 a new approach to the subgrade planning on the principles of environmental monitoring with the development of the general model for the geotechnical system management "Subgrade".

The notion "subgrade monitoring is based upon the notion "subgrade" as a geotechnical system, which is an object of management.

During embankment monitoring the following methods are used: seismic prospecting, electrical prospecting, hydrolacation, seismic-acoustical profiling, magnetic prospecting, georadiolocation, thermometry. Monitoring is carried out at specific times: monthly, quarterly. It is very important to detect the embankment destruction and not to rebuild the ruined embankment. For this purpose pressure sensors are proposed to use. In what follows they are united into the sensory field. First of all the sensory field is necessary on high embankments, embankments with a weak base and embankments on slopes. For this purpose there is a great variety of different pressure sensors on the ground. They have different not only sizes but technical abilities.

For timely deformation detection (settling as a result of soil compaction in an embankment; settling as a result of wet soil spreading, sliding of an embankment slope; shift of an embankment on a hillside; settling with base soil pressure; settling as a result of weak base extrusion; shift as a result of slope sliding; slope sling; weak soil extrusion) pressure and humidity sensors are to be used. Deformation processes in the foundation soil of the facility and the facility itself are caused by the redistribution of forces in the lithotechnical system (soil – facility). One of the main parameters, which are recommended for geotechnical monitoring, is the detection of the facility pressure on the foundation. For this purpose the soil pressure sensors are used.

The sensor consists of a pressure "pillow" and a measuring element, connected with each other by a steel tube. A pressure "pillow" consists of two steel

plates, welded together on the perimeter. The free space between them in the vacuum is filled with the air-free oil. The oil pressure is delivered on the connecting tube to the measuring element, so the sensor creates an open hydrolic system. The output electric signal is recorded by a portable registrar or an automatic registration complex.

Humidity sensors, hydristors, are resistive sensors, which change their resistance depending on the environment humidity. They can be made as a dielectric plate with conductors and they can be covered by a water-absorbing layer (for example, with a salt of strontium). The resistance of this plate varies under the humidity change. Depending on a staff of a covering layer, hygrostats can enlarge the resistance under the humidity growth, or reduce it.

Different modifications of the pressure and humidity sensors can be used in monitoring of the highway and railway embankment conditions, earth dams. They can be put in the abutment zone of the facility and the ground or hydrotechnical facilities.

**References**


1. Гинзбург В.Б. Магнитоупругие датчики. – М.: Энергия, 1970. – 72с.
2. Воробьев С.А. Электрические измерения неэлектрических величин. – Свердловск:УПИ, 1975. – 231с.
3. Гуманюк М.Н. Магнитоупругие силоизмерители. – К.: Техника, 1981. – 183с.
4. Методы и средства измерения неэлектрических величин. Под ред. Петухова В.И. – Рязань, 1973. – 154с.
5. С.Шалманов.Как работает GPS-мониторинг. (http://www.cnews.ru/cgi-bin/oranews/get_news.cgitmpl=com_print&news_id=156842)
6. Гурьев В.В.,Дорофеев В.М.Обеспечение безопасности работы несущих конструкций высотных зданий. (http://www.stroinauka.ru/detailview.aspd=12&dc=26&dr=5139)
7. Коряков В.И., Запорожец А.С. Приборы в системах контроля влажности твердых веществ и их метрологические характеристики. // Практика приборостроения. – 2002. – №1. – С. 5–11.
8. Ивченко Ю.А., Федоров А.А. Чем измерить влажность? // Датчики и системы. – 2003. – №8. – С. 53 – 54.
9. Баркалов Б.В., Карпис Б.Е. Кондиционирование воздуха в промышленных, общественных и жилых зданиях. Стройиздат, – М., 1971.