The disadvantage of this method, taken as a prototype, is the high complexity of the installation design, due to the fact that the metal beam is connected with bored piles by welding. One more disadvantage is the large metal structure and the absence of visual control over the design during the operation. The benefit of this way is that due to this invention pipeline is independent on any movements, which can be in the soil.

It is important to know that today a lot of companies use different sensors to determine karst problems, for example sensors, which are based on Barkhausen effect. This method represents one of the most reliable and efficient way to determine deformations. The Barkhausen effect is an indirect evidence of the existence of magnetic domains within ferromagnetic materials. When domains grow, under an applied magnetic field, the movement of the domain walls occurs by discontinuous and abrupt Barkhausen jumps. The jumps in magnetization of a ferromagnetic material can induce a voltage in a winding coil of wire which, in turn, can produce Barkhausen noise [2]. For excitation and detection of magnetic Barkhausen noise overhead sensors are used (Fig. 2). Transverse field dipole magnet of sensors generates varying magnetic field in the area which is close to a pipe. This magnetic field creates jumps of magnetization, consequently, in the receiving coil of sensor there is noise signal which is registered by a device. The level of magnetic noise depends on the properties and state of the crystal lattice and mechanical tension.

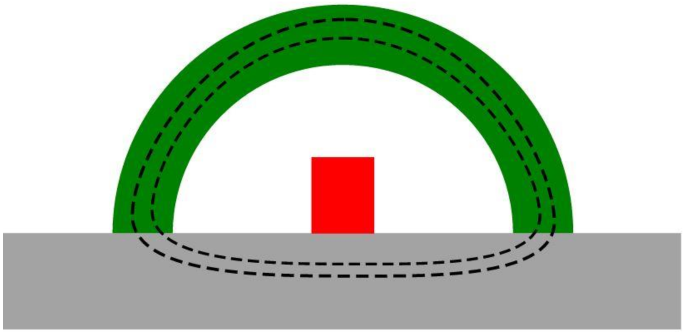

Fig. 2. A set-up for non-destructive testing of ferromagnetic materials: arc – magnetising yoke, square – inductive sensor, rectangle – sample of pipeline under test

In most types of steel under tension the intensity of the Barkhausen noise is increased, under compression- decreased. Control of the pipe deformation is based on this property. Moreover, this kind of sensors may be used in hard conditions. In particularly, the working temperature starts from −70 °C to +70 °C. It is very important for Chayandinskoye area. The disadvantage of this method that, it is not possible to use the sensor with the type of pipelines which were made from non-metal materials [4].

Thus, there are methods to detect sinkholes, as well as ways to predict and monitor the growth of cavities and protect pipelines from their negative impact. However, in spite of this karst is still the number one problem for specific regions. Unfortunately, an optimal solution that satisfies all the needs of humanity has not been found yet. Karst problem is a serious challenge for safe transportation of oil and gas that is why regular researches devoted to karst are continuing all over the world. The influence of natural factors on the stability of pipelines in karst areas has a huge impact on the development of petroleum industry, as well as it helps to attract investment to this knowledge-intensive field. In conclusion, analyzing all methods, which were mentioned here, it can be said that sensors based on Barkhausen effect is the best way of monitoring pipelines deformations. Indeed, the method provides optimal temperature range.

References

1. Al-Sayyal, E.B., Shiryaeva, T.S. 2008. Method for pipeline protection against emergency state caused by karst holes. Russian Patent 2316630.
2. Cullity, B.D. 1972. Introduction to magnetic materials. USA: Addison-Wesley Pub. Co.
3. Strokova, L.A., Ermolaeva, A.V. 2015. Natural features of construction of the main gas pipeline «The Power of Siberia» on a site Chayandinskoye oil and gas field - Lensk. Bulletin of the Tomsk Polytechnic University 327(1): in press.
4. Teterin, E.A., Strokova, L.A Methods for forecasting and protection pipelines from karst collapse. Proc. intern. symp.: Environmental safety and construction in karst areas, Perm, May 26 - 29 April 2015. Perm: PSU (in prep).

APPLICATION OF TIME-DOMAIN ELECTROMAGNETIC SOUNDING FOR DRAINAGE BRINE LANDFILL MONITORING

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Nowadays major diamond deposit mining in West-Yakutia province is mainly complicated due to underground mining of lower horizons of kimberlite pipes and brine (chloride and calcite) flooding of workings [1]. For more than two decades most drainage waters have been removed into cryolite subsurface using two most effective methods, such as reinjection into water-bearing horizons underlying the permafrost (used in open-pit mines “Mir” and “Internatsyonalny”); burial in the permafrost rock masses (Udachny quarry, a test site of designed Ajhal mine).

The Udachnaya deposit is located on the right bank of the Daldyn River, in the central part of its basin and refers to Mirninsky district of the Sakha Republic (Yakutia). This cryohydrogeological structure retains brine-saturated rocks with high reservoir parameters which are in sharp contrast to adjacent cryoartesian basins. Regime hydrogeological observations in the Udachnaya pipe area started in 1988 to monitor ground water dynamics. Udachny quarry mining is accompanied by drainage of brines which appear in workings and their subsequent injection into permafrost rocks (PR) in test sites “Oktjabyrsky”, “Kiengsky” and “Levoberezhny” (Fig. 1)

Fig. 1. An areal map of anthropogenic wastewater landfill location

Based on results of the conducted hydrogeological observations, the analysis of modern state of hydrogeological situation in the Udachnaya pipe area has been made. This made it possible to determine time and dynamics of depression cone development, as well as estimate ecological situation in Sytykan-Daldyn river basins considering technogenic factors and industrial zone of Udachny mining and processing complex. The geophysical surveying was performed via well-logging in step-out wells, hydrochemical sampling, time-domain electromagnetic sounding. Well-logging was carried out to delineate the section, identify reservoirs and determine their properties, and monitor technical condition of wells.

In well logging the station SGK-1 was used. This equipment includes tools developed by OJSC Research and Design Institute of Well Logging (RDIWL). For log recording digital registrator "Gektor” was used with proper software.

For the purpose of gas-hydrochemical condition monitoring within the quarry area and brine disposal area systematic hydrochemical sampling of ground waters in operational wells was conducted. Both water and gas sampling was performed using depth sampling device PO-38.

Time-domain electromagnetic sounding (TDEM) can be referred to as a reliable technique to trace the brine movement in faulted and fissured rock structures [3].

Fig. 2. Kiengsky test site. Time-domain electromagnetic sounding profile, September, 2012

Surface TDEM was conducted in Kiengsky test site to detect distribution boundaries of disposed drainage waters and their possible dynamics, as well as thickness of water-flooded section of FR down to the depth of 400 m (Fig. 2).

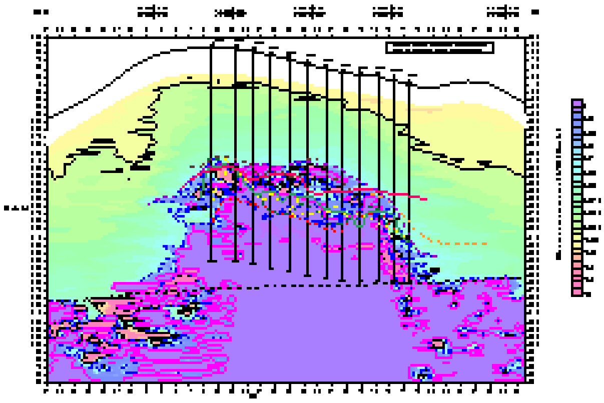

Fig. 3. Distribution boundaries of buried brines and level of Upper Cambrian aquifer system defined by electrical survey data

TDEM application yields good results for highly mineralized drainage brine investigations and it can be used to study permafrost rocks, to search for fault-fissured zones to establish landfill sites; moreover, to monitor distribution of injected brines in sites (Fig. 3). The main features of the method are large-scale depth and area coverage, high accuracy of measurements, enhanced value resolution with respect to cross-section parameters; great range of studied depths, simple operational technology.

Under certain conditions zones of regional tectonics in the upper part of sedimentary mantle, particularly, in cryolithosphere of West Yakutia can be referred to as proper structures for burial of drainage brines. Icy texture in frozen rocks being affected by highly mineralized brines, gravitational reservoir cavity occurs which makes it possible to use ecologically safe sections for mineralized water disposal.

References

1. Drozdov A.V. Towards formation of cryohydrogeological structures in Siberian platform // Science and Education, 2004, № 4, pp. 62-69.
2. Drozdov A.V. Underground disposal of brine drainage in permafrost (by the example of Udachny mining and processing complex in Western Yakutia) // Geoecology, 2005, № 3, pp. 234-243.
3. Kamenetsky E. F. Electromagnetic geophysical survey using time-domain electromagnetic sounding. - M.: GEOS, 1997, 162 p.

AUTOMATED DESIGN OF STIRRED VESSELS AND ITS 3D PARAMETRIC MODELING

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With implementation of computer technology into modeling of chemical equipment and productions moving higher capabilities of quick designing appeared with the use of programs such as HYSYS, Delphi etc. It is good implement into computer modeling of chemical – technological processes, but still a potential of applying of programs to calculating of chemical equipment is not fully achieved.

At the moment there are some services which let us to organize the automated design, but there are no real programs with special possibility to check different variants of alternate design of stirred vessels during mechanical calculation. This owes to difficulties of making design algorithms and scale of all sorts construction solutions which influence on technical data in a different ways.

Goals of this project are: automated design of vessels with stirring devices via Mathsoft MathCAD 14 and its 3D parametric modeling with the aid of table parameterization in Autodesk Inventor.

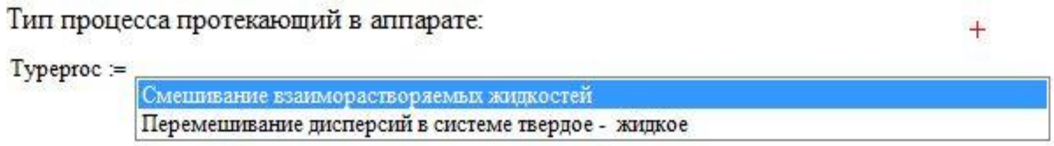

Fig. 3. Control element: «list box»

Automated calculation is based on writing sub-scripts, functions and using of control elements (Fig. 1). Realization of 3D model is made through exporting of a particular geometric data to Excel and its further Importing to Inventor (Table), (Fig. 2). Full calculating of stirred vessel is located in two separated data files with (.xmcd) extension.