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Coal Mine Water Level Detection and Reusability

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Abstract: ***Nowadays, groundwater is filling up the coal mines, making the coal in - useable. This system will help in detecting the groundwater level and alert the miners when the safe level is breached. The sensors placed will start the motor using IOT and pump the water to a treatment plant placed near the mine. Piezometer is a measurement device that can be used to detect the ground water level. This water will be treated and made useful. The pump will stop when the groundwater level has reached the safe groundwater yield level. The alert system is using IOT. The water extracted from the mines can be treated using different technologies. These technologies may include microfiltration, hyperfiltration, nanofiltration, ultrafiltration and reverse osmosis. After treating, this can be used for various purposes, daily needs of the miners etc.***

Keywords: IOT, Pressure Transducers, groundwater level, coal mines, piezometer

1. Introduction

Coal mines are getting filled due a rise in ground water level. These coals cannot be used for anything, making the efforts of the coal miners futile. The system suggested in this paper can be a solution to that problem. The Piezometer can measure and log the water level in various environments. These monitors can be used for measuring the ground water level in the coal mines. A pumping motor can be attached which pumps out the water in safe ground water yield level. If it goes beyond the safe ground water yield level, then it can cause harmful substance to enter the water making it unable to be treated. The other disadvantage of crossing the safe ground water yield level is that it can cause disbalance in the ground water level.

2. Objectives

- Identifying the ground water level
- Pumping out the water before it causes any damage
- Reusing the ground water

3. Piezometer

A piezometer can be a tool used to measure liquid pressure in a system by measuring the length at which the liquid column rises against gravitational force, or a device that measures the pressure (precisely, piezometric head) of groundwater at a certain point. The piezometer is designed to measure stationary pressure, and thus differs from the pitot tube by not detecting the flow of fluid.

The piezometers are also called as Casagrande piezometers. The piezometer will typically have a solid holder to the depth of interest, as well as a cable laid or filtered within the area where the water pressure is measured. The case is sealed with a pit excavation of clay, bentonite or concrete to prevent the surface water from contaminating the groundwater supply. In an uninsulated aquifer, the water level on the piezometer would not be exactly the same as the water table, especially when the upper part of the flow velocity is important. In a closed hole under artistic conditions, the water level on the piezometer indicates pressure on the aquifer, but not the water table. Piezometer springs can be much smaller in diameter than production springs, and a 5 cm wide standpipe is common.

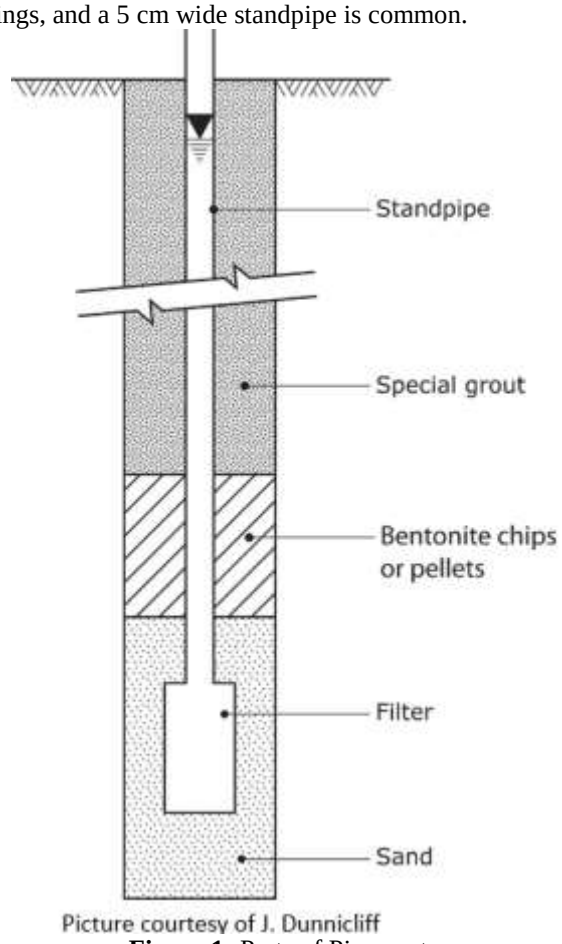

Figure 1: Parts of Piezometer

Piezometrics in solid casings can be buried or placed in the ground to measure the pressure of the groundwater in which it is deposited. The pressure gauges or pressure transducer can be vibrating - wire, pneumatic, or a working strain - gauge, which converts pressure into an electrical signal. These piezometers are fitted with a cable at the top where they can be read by data cutters or portable readout units, allowing faster or more frequent readings than open piezometers.

Figure 2: Piezometer

4. IoT

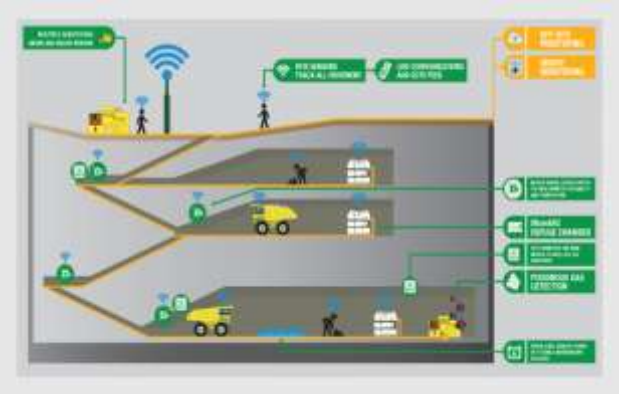

Figure 3: IoT used in Mining

Internet of Things (IoT) defines tangible objects (or groups of such objects), embedded in sensors, processing capabilities, software, and other technologies, and that connects and exchanges data with other devices and applications via the Internet, and or other network networks. IoT technology has been around for a long time, representing devices, sensors, devices and online devices. However, the mining industry is slow to embrace this technology, often deciding to stay with traditional and handmade mining processes. [1] Technologies such as artificial intelligence, machine learning, etc., are already being used in the mining industry, IoT solves sector challenges in the backbone, helping mining organizations operate more efficiently and save operating costs. Some of the advantages are:

A) Cost Utility
The mining organization's use IoT in their operations is to increase productivity and improve costs. By using sensors in mining hardware and equipment monitoring systems, miners can use big data, to find less expensive ways to perform their tasks and to improve the efficiency of these lines. Sensor deployments can also reduce the downtime of working, as organizations can use the data collected to train their equipment and prevent breakage.

B) Predictability
Having a fully integrated network, looking at each part of the operation becomes much easier and leads to outstanding performance and security. It contains the identification of cracks of important equipment fragments and speculation where repairs or repairs are needed.

C) Additional Control
IoT can help reduce downtime charges, issues will arise, and when they do occur, every minute is important in the repair competition. However, IoT can also help here. Engineers do not have to be in the actual location to prepare to be approved by management. They can log in remotely and help miners deal with problems, saving valuable time and valuable money.

D) Best Plant Design
Plant designing was one of the one IoT applications in the mining industry. Each plant is interesting with a unique set of hardware and flow paper with product distribution details. Sensor - like data collection devices are usually not set in predetermined areas in the flowsheet depending on the point

Figure 4: Benefits of IoT

of view during the basic construction. When shipped, these wireless gadgets become static, and are undoubtedly challenging to do more or better due to the extended and tedious process. Currently, with IoT communication technology, you can be very flexible. You can move the sensor and select which location is appropriate for data collection during production.

E) Improved Security
There is a real danger in the mining business, although new inventions have found how to remove some of them. The IoT can help prevent the deterioration of unreasonable barrels because the sensors will get real - time information and predict any faulty machine or where problems may occur, checking for repairs to be made before anything just goes wrong. Mining associations can similarly avoid accidents. In addition, a centralized IoT enabled system can provide better escape procedures and rescue operations in the event of an accident.

5. Model System

The miners can use the piezometer to measure and log the ground water level. These logs can be used to create an alert to notify when the ground water level increases. When alerted, miners can set an automation process to start a motor pump which can pump the water to a nearby treatment plant. The motor pump will stop when the level is reaches till it is in safe ground water yield level. Safe ground water yield level is the safe level till which the ground water can

be used for uses. If this level is crossed, the water may contain harmful particles which can cause dangerous effects in human and animals. In this treatment plant, the ground water can be treated so that it can be useful for the miners for their daily use. This can be done using microfiltration followed by reverse osmosis [2]. Microfiltration is a type of filtration process in which the contaminated liquid is transferred to a special membrane that measures the pore to separate microorganisms and suspended particles from the liquid process. It is often used in conjunction with various other separation processes such as ultrafiltration and reverse osmosis to provide a product stream free of unwanted impurities. Microfiltration is a pre - treatment for other isolation processes such as ultrafiltration, and post - filtration treatment for granular particles. Normal particle size used for microfiltration can range from about 0.1 to 10 µm. By the molecular weight of these molecules, these layers can divide the macromolecule of molecular weights usually less than 100, 000 g / mol. Filters utilized in the microfiltration process are specially designed to guard particles like sediment, algae, protozoa or large bacteria from specially designed filter transfer. Very small substances, atomic or ionic substances such as water (H2O), monovalent species such as Sodium (Na +) or Chloride (Cl−) ions, soluble or natural substances, and small colloids and germs will still be able to pass through the filter.

The fixed fluid is transmitted at a high speed of about 1 - 3 m/s and at low pressure to moderate pressures (approximately 100 - 400 kPa) in parallel or tangential fluid which cannot be found in paper or tubular form. The pump is usually inserted into the processing equipment to allow the liquid to pass through the membrane filter. There are also two pumps, either pressurized or vacuum - operated. A separate or standard pressure gauge is usually attached to measure the pressure drop between the outlet and incoming streams. Reverse osmosis is a purification process which uses a partial permeable membrane to remove pollutants from polluted water. This can remove chemical and organic particles which can cause dangerous disease from the water so that is can be potable for domestic and industrial uses. Reverse osmosis water processors are vended for water sanctification in different localities. For proper functioning, the water force to these units must be under a certain pressure (280 kPa (40 psi) or above normal). Reverse osmosis movable water processors can be used by people living in pastoral areas without clean water, down from megacity water pipes.

Membrane pores sizes can vary from 0.1 to 5, 000 nm depending on the type of filter. Particle filtering removes 1 µm or larger particles. Microfiltration eliminates particles of 50 nm or larger. Ultrafiltration eliminates particles of about 3 nm or more. Nanofiltration eliminates particles of 1 nm or larger.

Reversal osmosis is the final stage of membrane filtration, hyperfiltration, and it eliminates particles larger than 0.1 nm. Ultrafiltration (UF) is a type of membrane filtration in which forces such as pressure or concentration gradients lead to disintegration of the immeasurable membrane. Solid solvents and solvents with high molecular weight are retained in the so - called retentate, while water and low molecular weight pass through the membrane permeate (filtrate). This separation process is used in industry and research for the purification and solidification of macromolecular solutions (103 - 106 Da), especially protein solutions. Ultrafiltration is not fundamentally different from microfiltration. Both are classified according to size or particle size. It differs fundamentally in membrane gas separation, which is classified according to different absorption rates and different diffusion levels. Ultrafiltration membrane is defined by the determination of the molecular weight (MWCO) of the membrane used. Ultrafiltration is used in cross or die mode.

Nanofiltration is a membrane - based method that supports the membrane using nanometers the size of the pores passing through the membrane. The ribs used are mostly made from thin polymer films. The most commonly used materials include polyethylene terephthalate or metals such as aluminium.

6. Conclusions

The rise of ground water level in coal mines are making the coals unusable. Due to this, the extinguishing natural gas is wasted. This can be solved using the piezometer sensor with the help out IOT. We can use Microfiltration and Reverse Osmosis to treat the mine water to make it potable. We can also use Hyperfiltration, Ultrafiltration, Nanofiltration and membrane filtration as well for purification of the mine water.

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