MICROPROCESSOR BASED AUTOMATIC WATER LEVEL RECORDER

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ABSTRACT

Ground water is one of the most precious gifts nature has given to mankind. Civilizations have depended on it from the very beginning of their existence. Till recently we never bothered about the management of this resource and exploitation continued without giving any thought to the consequences. With the increasing demand for ground water because of rapid growth in population, industrialisation and agricultural industry, the declining levels of water levels are becoming serious cause for concern for the authorities.

Fortunately, it is being realised now that ground water management is not just another fancy term but a concept which must be practiced, to ensure that this precious resource continues to serve us in future as well. New technologies are being developed fast to ensure accurate data which can be used for hydrogeological, hydrometeorological, hydrological and hydrochemical parameter quantification.

In a country like India, with vast differences in geology, climatic conditions and other local preailing conditions, we cannot expect trouble free functioning from equipment developed in other countries. As all these equipments are used in the field, they require proper maintenance and after sales service, and for this purpose indigenous development of these equipment is being encouraged by agencies like the Central Ground Water Board, State Ground Water Departments and the World Bank.

The present paper highlights the latest Automatic Water Level Recorders with state-of-the-art technology and suitable for Indian climatic conditions. Basically two type of systems are discussed, suitable for different applications. More emphasis is given on the features required in our conditions and how optimum data collection is being achieved.

1. NEED FOR THE EQUIPMENT

Aquifer modelling ideally is one of the most important steps towards the management of ground water. The water level is one of the various parameters required for modelling purposes and at the same time the calibration of the aquifer model is also carried out against this parameter. The traditional methods of measuring water levels twice a year provide too little data for modelling purposes. The need was felt for equipments for more frequent and accurate recording. One desirable feature of such level recorders of course is unattended monitoring to save costs of manpower. Such equipments are used to monitor seasonal variations, in which case the sampling interval can be as high as a few days, and for pump test measurements with sampling intervals as low as a few seconds.

2. THE OLD GENERATION EQUIPMENT

The water level recorders of the first generation, now onwards termed as mechanical types, used a chart paper drum, pen, clock and float arrangement. In such equipment the float is suspended upto the water level through a pulley and a counterweight is used to keep the string in tension. The pulley is attached to a drum on which chart paper is wrapped. One pen is attached through a gear mechanism to a clock and this pen moves continuously on the drum at a speed determined by selection of the gears. As the water level fluctuates, the drum rotates with the movement of the float, and this movement gets recorded on the chart paper.

As might be evident from the description of the equipment itself, there were many difficulties involved in using such systems. The dry pen, moisture affected chartpaper, limited span of chart paper, low resolution etc made such equipments outdated.

3. FLOAT TYPE MICROPROCESSOR BASED AUTO-
MATIC WATER LEVEL RECORDER

With the advancement in electronics, the World has seen rapid change in instrumentation, including in the field of hydrology. The microprocessor based systems basically use RAM for data recording. Other features like internal clock etc. ensure timed and accurately spaced sampling. Because of the use of low power consuming devices, the

battery life is enhanced tremendously and this system has the capability to hold data without changing the battery for as long as ten years.

In such systems the same float and counterweight arrangement through a pulley is used, but the surface recording unit is completely micro-processor based. The pulley is directly attached to a potentiometer, which rotates with the rotation of the pulley. This rotation of the potentiometer is fed in the surface module in the form of varying voltage, which finally is recorded as the water level, once calibrated. The electronics used in the system ensure that even the smallest of fluctuations are recorded, thus enhancing the resolution. The entire unit is very small and capable of holding as much as 64,000 samples, which mean unattended continuous recording for 175 years (of course with battery changes in between) at a rate of one sample per day. Such systems are made compatible with computers so that the data can be unloaded directly on to computer and different operations like plotting, correlation, calculations performed. It saves a lot of time of the end user and meaningful interpretation for decision making becomes prompt and simpler. Other general and specific features of one such equipment being manufactured by Uptron India Limited are as follows:

4.   FEATURES

–   Rugged, low cost, battery powered, for reliable unattended monitoring in demanding environmental conditions.

–   10 year memory backup.

–   High accuracy real time clock.

–   –40°C to 75°C operating range.

–   Internal temperature sensor.

–   64K RAM memory.

4.1   Tracking Window Feature

Generally it has been observed that sometimes for long durations there is no significant change in water levels and if a small sampling interval is selected a lot of memory is consumed by useless data. At the same time if a high sampling interval is defined, any dynamic change in between the two samples would be lost. To overcome this problem, a special feature called tracking window has been incorporated. The

user defines a window which is basically the minimum variation he wants to get recorded. The logger keeps on scanning the level at all times but commits the data to memory only when the threshold is crossed. This ensures only useful data is stored in the memory and at the same time no dynamic data is missed out.

5. PRESSURE TRANSDUCER TYPE MICROPROCESSOR BASED AUTOMATIC WATER LEVEL RECORDER

In the above mentioned float type data logger there is physical movement of the float and counterweight which is sometimes not desirable in certain borehole conditions. At the same time, if such systems are to be installed at remote sites without any supervision, they are prone to vandalism.

To overcome this problem, the pressure transducer type down hole logger has been introduced. In such systems there are basically two parts, pressure transducer and data logger. The transducer is lowered in the well upto a point of maximum expected depression of water, whereas the data logger is suspended just near the top of the well. This way the complete system is inside the well and after proper installation the well can again be capped and sealed. This minimizes temperature effects and vandalism.

The small cylindrical design fits well casings as small as two inches in diameter. The system is self-contained with batteries and a reliable non-volatile flash EPROM memory. Special provision has been made to take care of atmospheric pressure variations and avoid condensation of moisture in the vented sensor and electronics.

The system comes with convenient user software which executes on an IBM compatible laptop computer. The software is used to initialize the data logger and configure it for long term unattended monitoring. It is also used to retrieve the data from the logger. The retrieved data is stored in a suitable format enabling the user to do functions like plotting, graphics and calculations etc.

Depending on the requirements of various areas, different models of the sensor have been introduced, as follows:

Model	Pressure Range	Depth Range	Accuracy
UP–05	0 to 05 psi	0 to 11.53 ft	±0.002 ft
UP–15	0 to 15 psi	0 to 34.60 ft	±0.007 ft
UP–30	0 to 30 psi	0 to 69.20 ft	±0.014 ft

Other features of the system include :

Number of sensors	:	01
Memory :	256 Kbytes	
Samples :	18600 samples	
Logging Interval	:	5 seconds to 24 hours,
	programmable	
Temperature	:	
Operation	:	0°C to 60°C
Storage :	–25°C to 80°C	
Humidity :	0 to 95%	

6.   SUMMARY

It is indeed heartening that after ignoring aspects of ground water management for a long time, we are finally gearing up for planned, careful use of this resource. The need of the hour is that all the agencies i.e. academic institutes, research institutes, exploration departments and manufacturing industry come together and work out the strategy. UPTRON, as a socially responsible organisation, is committed to help for optimal harnessing and proper management of ground water resources.