

METHOD AND APPARATUS FOR INDICATING SAMPLE COLLECTION TIMES DURING WELL DRILLING

BACKGROUND OF THE INVENTION

Field

The invention is in the field of mud logging, i.e., measuring and entering into an oil well log various measurements made concerning the oil well as it is being drilled, and the taking of drill cutting samples from desired well depths to provide information regarding the well.

State of the Art

It is common practice in oil well drilling operations to pump a drilling mud down through the drill stem and into the region around the drill bit during drilling. The mud then flows back up to the surface through the well bore outside the drill stem. The drilling mud is typically made up of clays and chemical additives in an oil or water base and performs several important functions. The drilling mud acts as a coolant and lubricates the drill bit during operation and it collects the drill cuttings and carries them back to the surface of the well. The drilling mud also serves to maintain a hydrostatic pressure to prevent pressurized gases from the earth from blowing out through the drilled well. In addition, the mud will pick up and entrain gases present in the bottom of the well and deliver them to the surface along with the drill cuttings.

It has been common in the past to provide a log of the drilling operation that will permit the nature of the earth formation through which the drill bit is penetrating to be analyzed. The log is important because it enables the drilling operator to ascertain the presence of oil or gas in the formation being drilled and also the location of such oil or gas in the well. As part of this logging operation, samples of the drill cuttings from predetermined depths of the well are collected and analyzed. Generally, these samples will be collected to represent a desired interval of drilling, such as every ten feet of well drilled or every thirty feet drilled.

The logging of a well, commonly called mud logging because the information recorded and drill cuttings collected and analyzed are obtained from the drilling mud reaching the surface of the well, is generally done on a manual basis by a person called a "mud logger." This person, usually with a background in geology, collects and analyzes the well drill cuttings obtained from the drilling mud, monitors the gases released from the drilling mud, and enters the information collected in a well log along with information concerning the depth of the well where the cuttings and gas originated. Thus, the mud logger keeps track of the depth of the well generally through the use of a depth measuring device on the drilling rig called a geograph and, having an approximate idea of the lag time, i.e., the time it takes mud at the bottom of the well to reach the top of the well, gained through occasional rough measurements of the lag time, estimates the depth from which a mud sample reaching the surface originated. All of the measurements and the measuring equipment require constant supervision so a logging operation generally involves two mud loggers each working alternate twelve hour shifts.

Lag time, the time required for drill bit cuttings and drill bit liberated formation gas to reach the surface after being drilled is generally determined every few

days or every several hundred feet of drilling by determining the amount of time required for a marker device, i.e., a small packet of carbide, multicolored rope, etc., to appear in the drilling fluid return line after being dropped into the drill pipe. This commonly used method is inaccurate in determining lag time because of the relative infrequency of the measurement and because a measurement based merely on time cannot accurately allow for changes in drilling fluid pump speed or for changing from one pump to another and the resulting change in pump output.

The measurement of lag is an important aspect in determining when samples of drill cuttings are to be collected for further examination. Samples, which comprise formation cuttings strained from the circulating drilling fluid as it reaches the surface of the well, are generally collected for microscopic examination at every ten feet or every thirty feet of well penetration. These samples are then representative of the drill cuttings produced through that ten foot or thirty foot interval. Sample collection times are generally determined by adding the lag time to the time when samples are drilled. Therefore, if a sample of drill cuttings from a well depth of 2500 feet has been collected and it is desired to collect samples at ten foot intervals, the next sample should be collected when mud from a depth of 2510 feet reaches the surface. The mud logger would determine when the well depth was 2510 feet, for example at 9:30 a.m., and then would add the lag time to determine when the sample should be collected. If the lag time had been determined by measurement to be one-half hour, the mud logger would add one-half hour to the 9:30 a.m. time and know that the next sample of drill cuttings should be collected at 10:00 a.m. and, if collected at that time, the drill cuttings should be those cut between the 2500 and the 2510 depth level of the well. However, if the lag time is not accurately determined and up dated, the samples collected are not representative of the desired depth. Further, merely adding the approximately determined lag time to the time the well reaches the desired depth does not allow for compensation necessary if, during that time, the drilling fluid pump speed changes, the pump used to pump the fluid changes, or the drilling rig temporarily stops drilling.

A further problem in collecting samples even where lag time can be fairly accurately determined is that a person must actually go to the area of the drilling rig where the mud is flowing from the well to collect the sample of drill cuttings and then properly package and label such sample for later evaluation. While a mud logger on duty can calculate the approximate time for collecting the sample, as indicated above, the logger's many other duties may interfere with his ability to keep track of the time a sample is due to be taken and thus interfere with timely sample collection. In many cases the collection of samples is left to drilling rig personnel. With logging units utilizing a single mud logger where the logging equipment is unattended at least twelve hours a day or with unmanned units where mud loggers only check the instruments periodically, the sample collection duties have to be left to drilling rig personnel. Drilling rig personnel have their own jobs to do and do not like collecting samples. Further, it is difficult for the rig personnel to keep track of the times when samples are to be collected and, since they are not involved in lag time calculations, generally base collection time on