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TECHNICAL MEMORANDUM

NO. 49 OF 1968.

THE F.R.I. RECORDING METHANOMETER - FIELD TRIALS.

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THE F.R.I. RECORDING METHANOMETER - FIELD TRIALS.

Field testing of the F.R.I. methanometer is in progress at D.N.C. colliery. This work was undertaken to investigate the reliability of the instruments and to train personnel to operate and service them before any extensive study should be started of the occurrence of methane in South African collieries.

Three methanometers were placed together in a return airway a short distance from the foot of No. 5 shaft at D.N.C. The methane concentration there remained almost constant at 0.4%. The remaining two methanometers of the five constructed are being held in the laboratory for further testing and calibration and to serve as reserve instruments.

The total operating experience obtained with three instruments up to the end of November is about eighteen instrument-weeks. During the first week of operation, two of the three methanometers became inoperative due to the ingress of moisture into the amplifier section of the instruments. The high relative humidity (90-95%) of the mine atmosphere caused electrical leakage paths to develop on the amplifier printed - circuit boards. This problem was overcome by enclosing the amplifiers in sealed boxes packed with an adequate amount of silica-gel as desiccant.

The chart paper of one of the recorders was prone to snag in the chart/drive with the result that records were lost for two consecutive weeks on this instrument. This fault is attributed to the high humidity which causes the chart paper to stretch but it can be prevented by ensuring that the chart-guides on the recorder are free and properly adjusted.

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The nominal capacity of the mercury cells used in the methanometer is 3600 mAh. and the current drain of the amplifier is 3 mA. A battery pack should therefore last for 50 days. Premature battery failure occurred in one case and it was decided to replace batteries on a routine basis when approximately 75% of their capacity is expended rather than to risk the loss of records. The batteries which are removed can be used for the remainder of their life for checking the methanometers in the laboratory. Battery failure is manifested by a prominent up-scale drift in the zero reading of the methanometer which is easy to detect. The electrical circuit of the methanometer is intrinsically safe and it is possible to replace batteries underground should the need arise.

No difficulty was experienced in changing the hydrogen supply cylinder with the instruments in situ. In practice the replacement cylinder is placed in position and the quick break connection transferred from the nearby empty cylinder to the full one within a matter of seconds. During the first week in operation the hydrogen flames of all three instruments were extinguished after a period of four days - probably due to a sudden change in atmospheric pressure as a result of the ventilation fan either stopping or starting. This problem was remedied by placing a restriction in the hydrogen jet so that the volume of gas in the tubing between the flow regulator and the jet is under a positive pressure of between 8 and 10 lb/sq. inch.

The manufacturers of the gas flow controllers used in the methanometers claim that the gas flow can be held constant to within 2% despite fluctuations in both up and downstream pressures. In practice this degree of accuracy cannot be maintained. The needle-valves in the controllers tend to creep from their set point and the hydrogen flow-rate gradually diminishes for a period of up to a week or more. The electrical ionization current generated at the flame is directly proportional to the hydrogen flow-rate and a 10% decrease in fuel flow will result in the methanometer reading 10% too low. The needle-valves were replaced by fixed capillary restrictions and this modification

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to the instrument is at present being evaluated.

After 5 weeks of continuous operation the three methanometers were brought to the surface and dismantled for a routine check. There was a hardly discernable dust deposit on the jet and lamp gauzes. It must be noted, however, that the return airway in which the methanometers are placed is relatively free of airborne dust.

Results typical of those obtainable with the F.R.I. recording methanometer are reproduced below. The records obtained on three instruments over a period of 14 hours are shown in Figure 1. The reason for the two-fold increase in methane concentration is not known. The extent and duration of the increase in methane concentration which followed a ventilation fan stoppage of \pm 2 hours is shown in Figure 2. The methane concentration increased to a maximum followed by a slower exponential decrease lasting for three hours before it reached its previous value. The fan stoppage was detected on the meteorograph (Temp., Hum., Bar.press.) which is placed in position with each methanometer.

The faults enumerated above are all of a mechanical nature and were rectified. The field trials have proved, so far, that the concept of the recording methanometer is sound and that it should prove suitable for monitoring methane concentrations between 0.1 and 1.0 percent in return airways with adequate accuracy. The instrument was designed and constructed solely with this purpose in mind.

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Research Officer.

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9th December, 1968.

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