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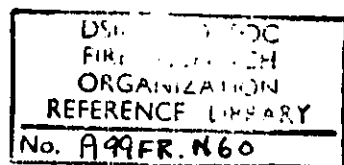
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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE  
JOINT FIRE RESEARCH ORGANIZATION

13978

THE EFFECT OF SURFACE TENSION ON THE PERCOLATION  
OF WATER THROUGH FIRE HOSE

by

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Summary

This note describes experiments to determine the effect of surface tension on the percolation of water through unlined canvas fire hose. In a comparison of tap water having its surface tension conditioned to two different values by addition of a wetting agent, it was shown that the rate of percolation decreased more rapidly from its initial value at the lower value of the surface tension.

Introduction

As part of a research programme on percolation through unlined canvas fire hose, the effect on the rate of percolation of varying the surface tension of the water used has been investigated.

The comparison was made between tap water having a surface tension of about 72 dynes/cm and a solution of wetting agent in water, having a surface tension of about 31 dynes/cm. The concentration of the commercial wetting agent used was several times that necessary to give the maximum possible reduction in surface tension, that is, to a surface tension of about 31 dynes/cm, in order to ensure that any variation of concentration between tank and hose did not produce a change in surface tension.

Experimental procedure

The tests were performed on eight 3 ft. lengths of unlined canvas fire hose, which had been conditioned in an atmosphere at 40°C having a relative humidity of 60 per cent. The specimens were cut from one length of hose and were selected randomly. Four (1-4) were tested with tap water and four (5-8) with the solution of wetting agent, in the following manner.

One end of the specimen was blanked off and the other was connected to a tank. The pressure in the hose was raised gradually to 100 lb. per sq. in. over a period of two minutes. The weight of water percolating during the following 5 minutes was measured, and thereafter measurements were made at intervals of 5 minutes up to 30 minutes and finally at 45 minutes. The temperature of the water was recorded in each test.

The surface tension of the liquid at the inlet to the hose, prior to the test, and after percolating through the hose, was measured with a Du Noüy tensiometer.

## Results

The variation of the total quantity of percolation with time is shown for the eight specimens in Fig. 1. From these curves, the rate of percolation at different times has been calculated and is shown for the individual specimens as dotted curves in Fig. 2. The average rate for each of the two sets of four specimens is also shown as a full curve.

It was found that there was negligible difference in the surface tension of the tap water and of the solution, before and after percolating through the hose. The average surface tension of the tap water was 72.5 dynes/cm and of the solution of wetting agent in water, 31.5 dynes/cm.

## Conclusions

It may be seen from Fig. 2 that when the solution of wetting agent was used, the rate of percolation decreased more rapidly with time, from its initial value, than it did when tap water was used. The initial rates of percolation were, in view of the large initial rate of No. 6, not found to be significantly different between the two sets of specimen. Within 5 minutes, however, the rate of percolation of wetting agent solution was found to be from two to four times less than that of tap water. A possible explanation of this fact may be that the wetting agent solution causes a more rapid wetting of the fibres of the hose, and the more rapid swelling of the fibres consequent upon this restricts the rate of percolation more quickly.

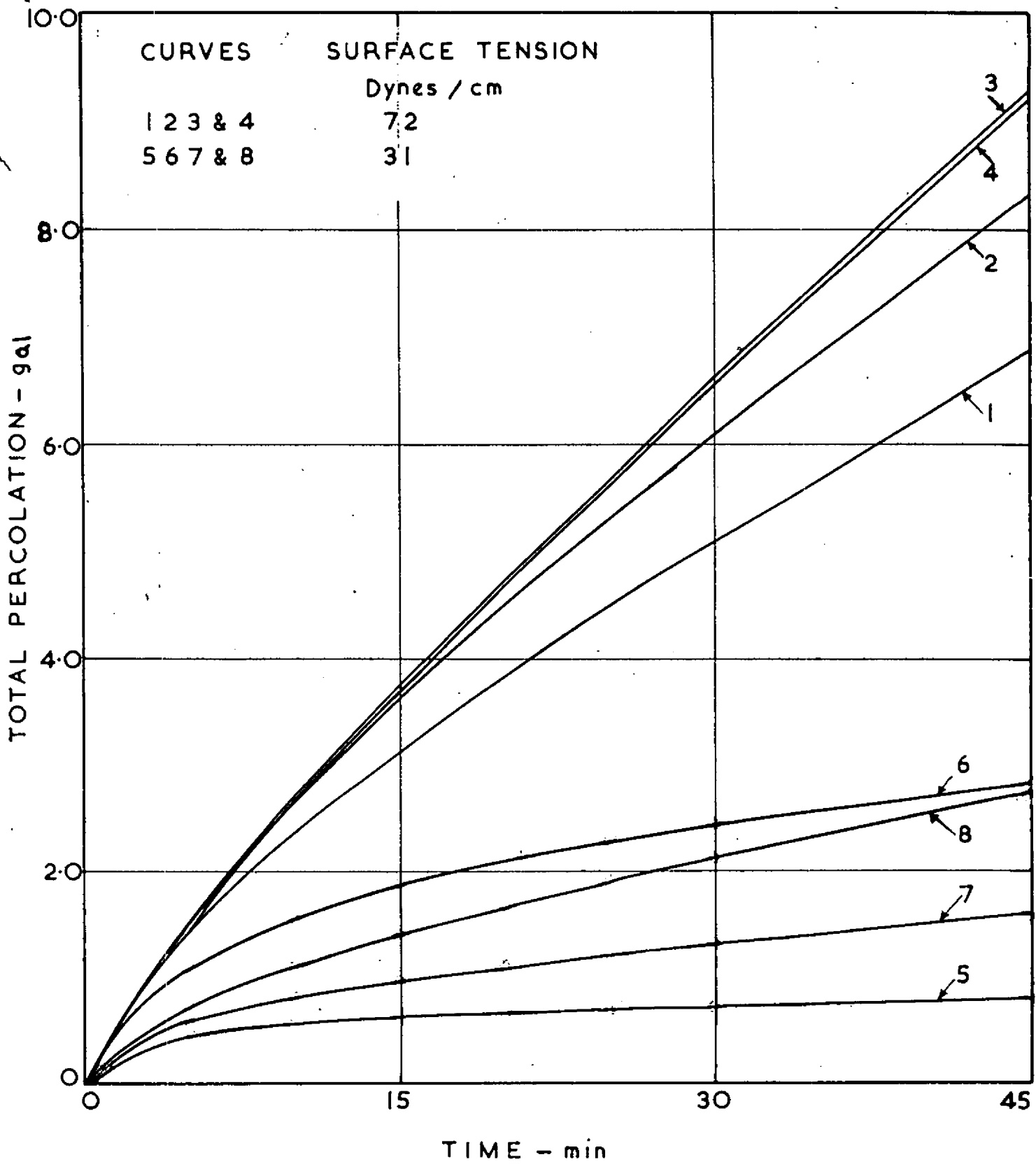
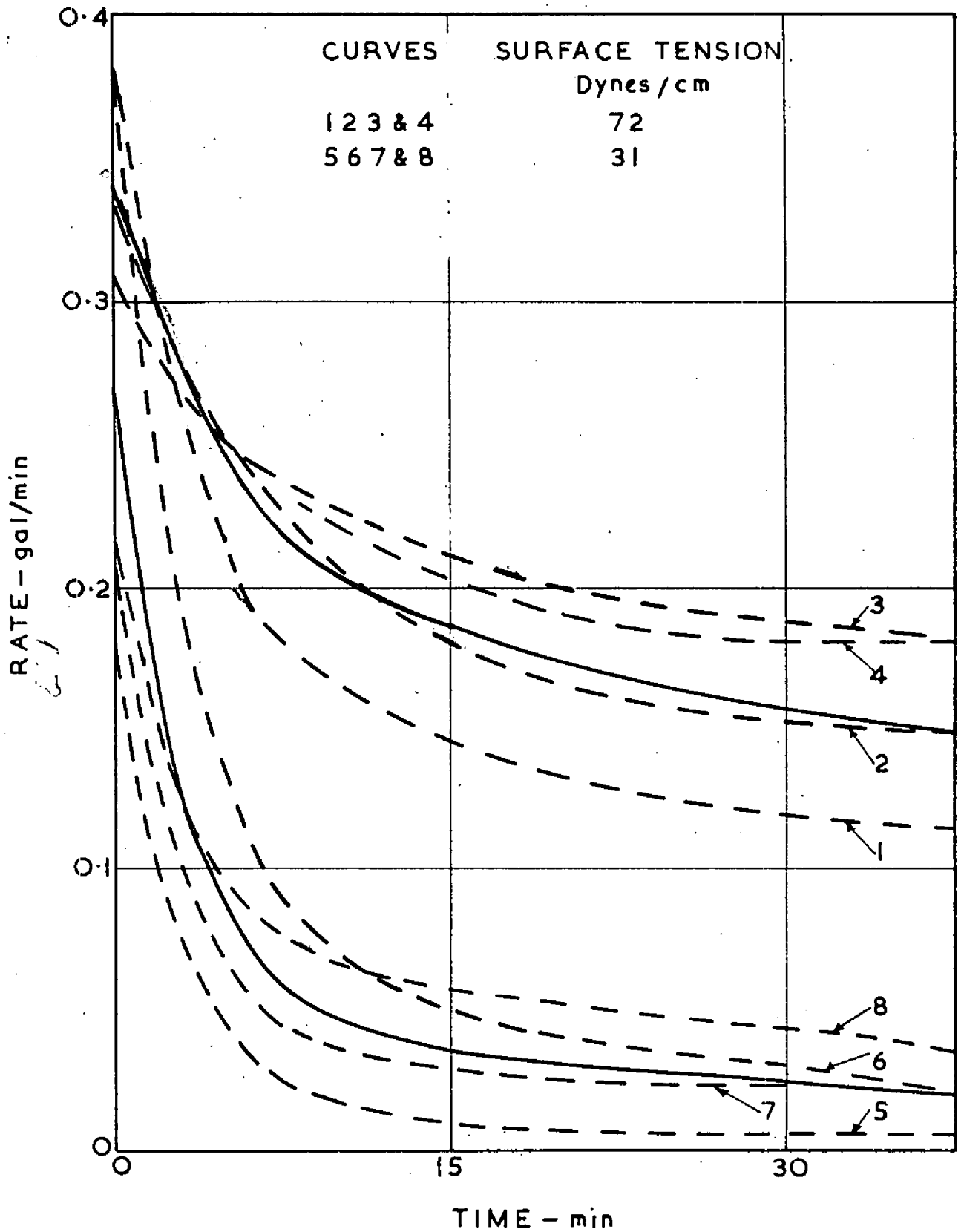


FIG. I. THE VARIATION OF TOTAL PERCOLATION WITH TIME FOR TAP WATER AND WETTING AGENT SOLUTION



The average for each set of four curves is shown as a full line

FIG.2. THE VARIATION OF RATE OF PERCOLATION WITH TIME FOR TAP WATER AND WETTING AGENT SOLUTION