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

THE POSSIBLE FIRE HAZARD OF OIL DRIP TRAYS USING SAND OR SAWDUST AS AN ABSORBENT

by

G. H. J. Elkins

Summary

In connection with the possible fire hazard associated with the use of sand or sawdust as an absorbent in oil pump drip trays, tests have been made to assess the extent to which sand and sawdust, impregnated with some fuel and lubricating oils, will burn with a self-supporting flame after ignition by a small source.

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Introduction

As a result of an enquiry on the fire hazard associated with oil drip trays under fuel oil pumps, some simple tests have been carried out on the ignitability of mixtures of oils and porous materials such as sand and sawdust, which are sometimes used as absorbents in drip trays. The problem is related to burning on wicks, but insufficient is known about the subject to render ad hoc tests unnecessary. The tests described in this note comprise the ignition of some fuel and lubricating oils at varying concentrations in sand and sawdust using a common small source of ignition, namely, a lighted match.

Experimental

Materials

Sand 100 per cent through 30 mesh B.S. sieve.
60 per cent through 36 mesh B.S. sieve.

Sawdust Mixed hardwoods.

100 per cent through B. S. 12 sieve.
62 per cent through B. S. 25 sieve.

Moisture content 9.64 per cent of dry weight.

Oils The oils used comprised two fuel oils as used in domestic appliances, one penetrating oil, and four lubricating oils as used in a wide variety of machinery. Their characteristics are given in Table 1.

Table 1

Characteristics of the oils used in experiments

No.	Description	Flash point Cleveland open cup (1) °F	Fire point °F
1	Penetrating Oil Shell Donax P	165	180
2	B.S. 742 (2) Class A Fuel Oil (Gas Oil)	190	200
3	B.S. 742 Class B Fuel Oil (Britoleum)	195	225
4	Lubricating Oil Shell Tellus 27	405	455
5	" " Shell Talpa 30	425	480
6	" " Shell Vitrea 47	435	470
7	" " Shell Tractor 50	520	580

Experimental

The oils and solid materials in test mixtures were mixed to uniform colour and consistency. The mixtures were lightly tamped into a rectangular mould 3 in x $1\frac{1}{2}$ in x $\frac{1}{2}$ in resting on a metal plate, and the mould removed. A lighted match was held against a vertical end face until a self-supporting flame was established on the test material or until the match had burnt out. In the latter case and in the case where an independent flame travelled a short distance only, a second ignition was attempted on the other end face. When self-supporting burning took place, the area of the top surface covered by the flame, the time taken for the flame to cover this area and the total time that self-supporting burning continued were all recorded.

A lighted match was used as the source of ignition rather than a more precise standard flame as this represents a very common small source of ignition. By applying it by hand until ignition was achieved or the match burnt completely out, the flame could be applied in the manner most favourable for ignition and thus the test for ignition was as severe as possible for this source.

The maximum concentrations of the oils in sand were limited by the fact that the sand/oil mixtures tended to become fairly free flowing when the concentrations of oil in the sand exceeded about 25 per cent of the dry weight of the sand. Higher concentrations gave rise to pools of oil on the surface of the mixture, a somewhat different condition to that under investigation. With the sawdust/oil mixtures it was possible to use much higher concentrations of oil. The tests were started with mixtures containing the maximum concentration of oil used; in successive tests the oil concentration was halved until a concentration was reached at which a self-supporting flame either failed to occur or, in the sawdust/oil mixtures, covered less than one-third of the surface area.

Results

The results obtained are tabulated in Tables 2 and 3. Where two ignitions were attempted, both giving rise to short-lived flames, the times and areas given are the maximum values obtained.

Table 2

Results obtained with sand oil mixtures

Oil No.	Concentration of oil g. per g. sand	No. of ignitions attempted	Spread of flame	Time of spread mins.	Time of spread sec.	Total burning time mins.	Total burning time sec.	Notes
1	0.20	2	Total	6	0			
	0.16	2	Local			1	0	
2	0.12	1	Total	3	50	6	16	
	0.063	2	Nil					
3	0.33	2	Nil					Mould collapsed
	0.26	2	V.small				3	Partial collapse
	0.13	2	Nil					
4	0.32	2	Nil					Mould collapsed
	0.25	2	Nil					Partial collapse
	0.19	1	V.small					
5	0.21	2	Nil					
6	0.24	2	Nil					
	0.20	2	Nil					
7	0.25	2	Nil					Partial collapse
	0.12	2	Nil					

Table 3

Results obtained with sawdust oil mixtures

Oil No.	Concentration of oil g per g sawdust	No. of ignitions attempted	Spread of flame per cent total area	Time of spread mins.	Time of spread sec.	Total burning time mins.	Total burning time sec.
1	1.78	1	100		25	15	0
	1.09	1	100		36	10	55
	0.55	1	100	1	0	6	40
	0.26	1	100	6	30	10	11
	0.13	2	20			2	50
2	0.99	1	100		11	10	20
	0.48	1	100		30	7	45
	0.26	1	100	2	10	6	49
	0.14	2	50			3	27
	0.08	2	17			1	35
3	0.99	1	100	1	10	8	45
	0.51	1	100	2	45	7	2
	0.24	2	25			1	40
4	1.03	1	100	1	40	13	10
	0.40	1	85			9	48
	0.23	2	33			6	53
5	0.98	1	100	2	0	11	49
	0.61	1	100	9	0	14	42
	0.33	2	25			3	0
6	1.00	1	100	8	50	18	17
	0.49	1	100	15	0	20	0
	0.23	2	33	3	40	3	40
7	1.52*	2	80			17	30
	1.07	2	95			9	50
	0.53	2	8			1	23

*Residue did not smoulder.

In all cases except the one noted above, the residual mixture continued to smoulder. With some of the sawdust oil mixtures burning occurred in two stages, and the body of the material in a pile did not always smoulder internally until the second stage. This was most noticeable with the lower concentrations of oil.

In the first stage a thin flame advanced over the surface leaving a charred area behind. Then in the second stage this flame died down to a pale blue flame which lit back to involve the charred area again. When this occurred the flame gradually withdrew to the centre of the pile before going out, leaving a charred mass which smouldered.

Conclusions

The results obtained with the sand/oil mixtures show that with the exception of the Class A fuel oil ignition of such mixtures by a source such as a lighted match is unlikely. When the amount of oil is increased to give a free flowing mixture, the ignitability of such a mixture may be expected to approximate to that of a pool of oil, the ignitability of which is better indicated by its flash point.

With all the oils tested the sawdust/oil mixtures proved to be ignitable by a lighted match and burned readily even when hardly moist with oil as in the case of the lower concentrations of oils tested.

It seems probable that if sawdust were used as an absorbent in a drip tray, the concentration of oil would reach a much higher level than those tested and these mixtures also might ultimately behave as pools of oil. Nevertheless, the probability of a small source igniting oil/sawdust mixtures before saturation will be fairly high.

Acknowledgments

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References

1. Institute of Petroleum. Standard methods for testing petroleum and its products. 14th Edn. 1955, p. 253.

2. British Standard 742. Fuel oil for burners, 1947.