

OUTGASSING PHENOMENON IN FLASH POINT TESTING FOR FIRE SAFETY EVALUATION

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Introduction to the Outgassing Phenomenon

Accurate ignitable liquid flash point testing provides an important component in the evaluation of a liquid material's relative flammability danger. "Outgassing" is the condition in a flash point test in which the vapors of nonflammable components of a liquid mixture tend to inert the vapor space of the testing apparatus, while the gasses evolved to the atmosphere outside the test cup are ignitable. Outgassing can mask the true flammable nature of a substance. This

outgassing phenomenon most frequently occurs with liquids that contain certain halogenated hydrocarbons such as Dichloromethane (Methylene Chloride) in mixtures of ignitable liquids. When using industry standard flash point tests in the fire safety evaluation of certain common consumer and industrial products, the phenomenon of outgassing has long been known but frequently overlooked. Improper understanding of this flash point behavior and the inappropriate application of the standards has led

to the dangerous mislabeling of consumer products and undue public safety risks. The current research reported here was undertaken in order to provide further study and publicize this phenomenon. Laboratory tests were conducted according to ASTM Standards on commercially available products containing halogenated hydrocarbons, as well as on pure methylene chloride.

Normal Closed Cup Test



Closed Cup Normal Test Flame



Closed Cup Halo



Closed Cup Flash (p-xylene)

Outgassing

- Found in mixtures containing Halogenated Hydrocarbons. (i.e. Methylene Chloride)
- Heavier non-flammable vapors inert the Flash Point test chamber while the vapors outside the apparatus are highly flammable.
- Does not yield a true flash point.

Halo Effect v. Enlarged Supply Flame

- "Halo effect" is a small blue outer edge of the test flame observed in normal flash point tests as the material approaches its flash point.

- Enlarged test flames are caused by flammable vapors being forced out of the test chamber by heavier, inert components.
- Enlarged test flames are considerably larger in size and vary in shape and color from normal "halo"
- Flame enlargement is an indicator of outgassing.

Dangers of Outgassing

- Outgassing can mask the true flammable nature of a substance.
- Gives an underestimation of the true flammability of these liquids.
- Prevents the accurate evaluation and labeling of product's dangers by manufacturers, suppliers, shippers.
- Increases risks to consumers.

Normal Open Cup Test



Open Cup Normal Test Flame



Open Cup Halo



Open Cup Flash (p-xylene)

Results

PRODUCTS TESTED		TEST APPARATUSES			
		TAG Open Cup	TAG Closed Cup	Setaflash Closed Tester	Pensky-Martens Closed Tester
p-Xylene	Outgassing (YES or NO)	NO	NO	NO	NO
	Flash Point	93°F (33.9°C)	80°F (26.7°C)	82°F (27.7°C)	82°F (27.7°C)
Methylene Chloride (CH₂Cl₂)-Pure	Outgassing (YES or NO)	YES	YES	YES	YES
	Flash Point	NO	NO	NO	NO
p-Xylene: 10% CH₂Cl₂	Outgassing (YES or NO)	YES	YES	YES	YES
	Flash Point	105°F (40.5°C)	NO	NO	NO
Commercial Product - A	Outgassing (YES or NO)	YES	YES	YES	YES
	Flash Point	113°F (45°C)	NO	NO	NO
Commercial Product - B	Outgassing (YES or NO)	YES	YES	YES	YES
	Flash Point	84°F (28.9°C)	NO	NO	NO
Commercial Product - C	Outgassing (YES or NO)	YES	YES	YES	YES
	Flash Point	~110°F (43.3°C)	NO	NO	NO

Conclusions

A single test, such as a flash point test, should not be completely relied upon to portray the definitive flammability danger of a material. Manufacturers and/or suppliers of such materials should be held accountable to review the process and handling conditions of the material thereby designating any additional testing required. For instance, if a material generates no distinguishable flash point, the manufacturers and/or suppliers should review other physical characteristics of the material to aid in correctly distinguishing the relative flammability danger. A test which would accurately define a material's relative flammability is ASTM's Flammability Temperature Limit or UL's Temperature of Flammability

Outgassing Tests



Closed Cup Outgassing - Enlarged Test Flame



Open Cup Enlarged Flame - Outgassing



Open Cup Flash - Outgassing (Halogenated Hydrocarbon)

Outgassing in Testing Standards

The current literature and test standards fail to adequately address the effects of the outgassing phenomenon. There are no required or mandatory references within the current literature and/or test standards that address this phenomenon. However, references are made within some nonmandatory appendices. Most importantly, ASTM E 502, *Standard Test Method for Selection and Use of ASTM Standards for the Determination of Flash Point of Chemicals by Closed Cup Method* identifies possible issues. Unfortunately, ASTM D502 is a relatively obscure Standard and is rarely known or considered by product manufacturers.