Fastness and resistance properties of specialty carbon blacks

Technical Information TI 1480

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This technical information provides an overview about material registration status, fastness and resistance properties of specialty carbon blacks compiled from the National Printing Ink Research Institute (NPIRI) and the Association of Colour Chemists. Specialty carbon blacks are used in many applications and products such as printing inks, coatings, plastics, fibers, paper, metal carbides, construction, insulation and fireproofing, which often require excellent resistance properties of the final pigmented preparation. Such requirements mainly concern light fastness, chemical resistance and heat resistance, where carbon black shows superior performance. For example, specialty carbon blacks are inherently resistant to water, acids, organic solvents and other chemicals. In applications where colour is important, the attack of light (UV or visible radiation) and/or variations in weather and temperature conditions do not lead to any impairment of the coloristic properties.

In general, the fastness and resistance properties of pigmented preparations such as printing inks or coatings are influenced by multiple factors such as:

- The thickness of the printed or coated film
- The transparency of the film
- The pigmentation of the film
- The filler or white pigment content of ink or coating

In preparations containing carbon black where poor fastness or resistance properties are observed, the limitation is not the specialty carbon black itself but most often the binder system in which the specialty carbon black is embedded.

The resistance properties of specialty carbon blacks that are described in tables 2-3 refer to all specialty carbon black grades, regardless of the manufacturing method used. Furnace black, gas black as well as LAMP BLACK manufacturing processes result in very high purity - mostly greater than 96 % of elemental carbon with smaller quantities of oxygen, hydrogen, nitrogen and sulphur. Exceptions are oxidatively treated specialty carbons blacks which may contain up to 20 % volatiles.

An overview about material registration data of specialty carbon blacks is given in table 1.

Table 1
Material registration data of specialty carbon black

Institution	Furnace black, gas black	LAMP BLACK
CAS (Chemical Abstracts Service)	1333-86-4	
MITI (Ministry of International Trade and Industry Japan) Section/Class Reference No.	10-3074/5-3328	10-3073/5-5222
EINECS (European Inventory of Existing Commercial Chemical Substances) No.	2156099	
Listed on Korean Existing Chemicals List No.	KE-04682	

Table 2

Colour index classification and fastness data

Colour index*		
	Furnace black, gas black	LAMP BLACK
Chemical class	Inorganic	
Colour index generic name	Pigment Black #7	Pigment Black #6
Colour index constitution no.	77266	
Fastness data		
Organic solvents[1]	Insoluble	
Light[2]	Excellent	
Heat[3]	Excellent	
Water[4]	Insoluble	
Alkalis[5]	Unaffected	
Acids[6]	Unaffected	
Linseed oil[7]	Insoluble	
Oleic acid[7]	Insoluble	

Table 3

NPIRI fastness data and colour permanency

NPIRI**		
	Furnace black, gas black	LAMP BLACK
Chemical class	Inorganic	
Colour index generic name	Pigment Black #7	Pigment Black #6
Colour index constitution no.	77266	
Fastness data		
Water (20°C, 100 °C, process steam sterilization)[8]	No bleed or discoloration	
Acid (Hydrochloric Acid 5%, Lactic Acid 3%, Acetic Acid 2 %)[9]	No bleed or discoloration	
Alkali (Sodium Hydroxide 2%, Sodium Carbonate Solution 5%)[10]	No bleed or discoloration	
Organic solvents (non-polar, polar)[11]	No bleed or discoloration	
Chemicals (plasticizers, oils fats, greases, hot wax, soap)[12]	No bleed or discoloration	
Colour permanency		
Indoor: Lightfastness in carbon arc or xenon lamp fadeometer[13]	No bleed or discoloration	
Outdoor: Weathering tests in Florida[14]	No bleed or discoloration	
Baking stability[15]	No bleed or discoloration	

[1] "Insoluble" means excellent fastness and refers to solubility at room temperature.

[2] Lightfastness corresponds to the British Standards Institutions 1-8 scale. "Excellent" means 7-8 scale whereas scale 5-6 corresponds to "very good".

[3] Effect of heat on a pigment is recorded on melting point, the temperature above which sublimation may become serious, the temperature up to which the pigment is stable and change in shade when heated above the stable point.

[4] "Insoluble" takes the place of "excellent". It will be readily understood that pigments which have a slight solubility and are described as very good in water fastness may be virtually insoluble when incorporated in some media.

[5] Test in 5 % solution of sodium carbonate at room temperature. "Unaffected" takes the place of "excellent "and means that on exposure to the alkali there is neither bleeding nor alteration of shade.

[6] Test in 5 % solution of concentrated hydrochloric acid at room temperature. "Unaffected" for fastness to alkalis means that there is neither bleeding nor alteration in shade.

[7] "Insoluble" means no bleeding of the pigment into the agent at room temperature.

[8] At 20°C: Dry pigment immersed in water
At 100 °C: Print immersed in boiling water or heated up in oven
Process sterilization: Exposing to wet steam; autoclave at 120°C, 1 atm; exposure times 20 - 60 min.

[9-10] Test conditions: Dried coating pigmented film which can be a)immersed in the chemical, b) spotted with drops or c) sandwiched between filter or blotting papers wetted with chemicals.

[11] Mostly, dry pigment is immersed in the solvent; pigment concentration 0.5 - 4 %; Shaking/standing times vary from 5 min to 24 h.

[12] For plasticizers: Pigment is directly dispersed. Paste is spotted on filter paper and colour change evaluated after 6 to 24 h at room temperature and oven heated at 175°C.
For linseed oil or litho varnish: Procedure similar to that for plasticizers except colour is evaluated after 5 - 20 h at temperature from 20°C to 50°C.
For fats and greases:
a) Pigmented paste can be immersed in grease heated to 200°C, then spotted on paper,
b) Metal panel can be dipped in 80°C grease for 10 min,
c) Filter paper spotted with grease can be wrapped around a print for 6 h at 50°C, or d) A print can be is pressed on butter for 24 h at 20°C.
For wax: Immersing dry pigment, a dried litho varnish drawdown, flexo or letterpress print in paraffin at 80°C for 5 min to 1 h. Alternatively, sandwiching a paste in waxed paper and heat it up for 2 h.
For soaps: Most popular is sandwich method, placing a print between two freshly sliced pieces of Ivory soap. Storage conditions include 24 h at room temperature, 80°C for 72 h or 50°C for one week. Other test methods used are sandwiching a print in filter paper wetted with soap solution or wrapping the print around a soap gel for 6 h at room temperature.

[13] Degree of colour change is evaluated for full strength and tinted coating at 72 - 80 hours. Tint concentrations normally vary between 1:1 and 1:50 in titanium dioxide.

[14] Weathering tests conducted in Florida with paint panels positioned at 45° and facing south. The colour change is evaluated after 12 month storage time.

[15] Degree of colour change is evaluated at 150°C for both 15 min and 30 min baking temperature.

* Source: Colour Index, 1971, Volume 2-4, The Society of Dyers and Colouristics, The American Association of Textile Chemists and Colorists

** Source: NPIRI Raw Materials Data Handbook Volume 4 Pigments, Second Edition August 2000 compiled by Jacqueline M. Fetsko and George Fuchs

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