SAFETY DATA SHEET

Prepared in accordance with the Australian National model Code of Practice for the Preparation of Safety Data Sheets for Hazardous Chemicals

CARBON BLACK

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product Identifier

Chemical name: Carbon Black

This SDS is valid for the following:
BCD, Conductex®, Copeblack®, PM, Raven® – powder or beads, including Ultra® versions of these products.

Raven®				
14	1040	1100	1255	5000 U3
965	1060	1180	3500	7000
1035	1080	1185	5000 UII	BCD 5102

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses: Additive for plastic and rubber; pigment; chemical reagent, additive for batteries, refractories, various.

Uses advised against: Pigments in tattoo colors for humans.

1.3 Details of the supplier of the safety data sheet

Manufacturer: See Section 16
Columbian Chemicals Company
1800 West Oak Commons Court
Marietta, Georgia 30062, USA
+1 (800) 235-4003 or +1 (770) 792-9400

Email Address: BC.HSE@adityabirla.com

Emergency Telephone Numbers: Australia CHEMTREC: +61 290 372 994
US CHEMTREC: +1 703 527 3887 or 1-800-424-9400

SECTION 2: Hazard(s) Identification

2.1 Classification of the substance or mixture

Australia: Not a hazardous substance or mixture according to the Globally Harmonized System (GHS) Rev. 3, referred to by the Australia Model Work Health and Safety Regulation (WHS).

2.2 Label elements

Pictogram: None

Signal Word: None

Hazard Statement: None

Precautionary Statement: None

2.3 Other hazards

This substance is classified as hazardous as a combustible dust by the United States 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200) and the Canadian Hazardous Products Regulation (HPR) 2015. The signal word, hazard statement and precautionary statements in the United States and Canada are: WARNING May form combustible dust concentrations in air. Keep away from all ignition sources including heat, sparks and flame. Prevent dust accumulations to minimize explosion hazard. Do not expose to temperatures above 300°C. Hazardous products of combustion can include carbon monoxide, carbon dioxide, oxides of sulfur, and organic products.

Eye: May cause reversible mechanical irritation.

Skin: May cause mechanical irritation, soiling, and drying of skin. No cases of sensitization in humans have been reported.

Inhalation: Dust may be irritating to the respiratory tract. Provide local exhaust ventilation. See Section 8.

Ingestion: Adverse health effects are not expected.

Carcinogenicity: Carbon black is listed by the International Agency for Research on Cancer (IARC) as a Group 2B substance (*possibly carcinogenic to humans).* See Section 11.

SECTION 3: Composition/information on ingredients

3.1 Substance

3.1.1 Carbon Black (amorphous) 100%

3.1.2 CAS Number: 1333-86-4

3.1.3 Synonyms: carbon black, furnace black

SECTION 4: First-aid measures

4.1 Description of first-aid measures

Inhalation: Take affected persons into fresh air. If necessary, restore normal breathing through standard first aid measures.

Skin: Wash skin with mild soap and water. If symptoms persist, seek medical attention.

Eye: Rinse eyes thoroughly with large volumes of water keeping eyelids open. If symptoms develop, seek medical attention.

Ingestion: Do not induce vomiting. If conscious, give several glasses of water. Never give anything by mouth to an unconscious person.

4.2 Most important symptoms, both acute and delayed

Symptoms: Irritating to the eyes and respiratory tract if exposed above the occupational exposure limits. See Section 2.

4.3 Indication of any immediate medical attention and special treatment needed

Note to physicians: Treat symptomatically

SECTION 5: Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media: Use foam, carbon dioxide (CO_2), dry chemical, or water fog. A fog spray is recommended if water is used.

Unsuitable extinguishing media: Do not use high pressure media which could cause the formation of a potentially explosible dust-air mixture.

5.2 Special hazards arising from the substance or mixture

Special hazards arising from the chemical: It may not be obvious that carbon black is burning unless the material is stirred and sparks are apparent. Carbon black that has been on fire should be closely observed for at least 48 hours to ensure no smoldering material is present.

Hazardous Combustion Products: Carbon monoxide (CO), carbon dioxide (CO_2), and oxides of sulfur.

5.3 Advice for fire fighters

Special protective equipment for fire-fighters: Wear full protective firefighting gear, including self-contained breathing apparatus (SCBA). Wet carbon black produces very slipper walking surfaces.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal precautions: Wet carbon black produces slippery walking surfaces. Avoid dust formation. Wear appropriate personal protective equipment and respiratory protection. See Section 8.

For emergency responders: Use personal protective equipment recommended in section 8.

6.2 Environmental precautions

Environmental precautions: Carbon black poses no significant environmental hazards. Contain spilled product on land, if possible. As a matter of good practice, minimize contamination of sewage water, soil, groundwater, drainage systems, or bodies of water.

6.3 Methods and materials for containment and cleaning up

Methods for containment: Prevent further leakage or spillage if safe to do so.

Methods for cleaning up: Small spills should be vacuumed when possible. Dry sweeping is not recommended. A vacuum equipped with high efficiency particulate air (HEPA) filtration is recommended. If necessary, light water spray will reduce dust for dry sweeping. Large spills may be shoveled into containers. See Section 13.

6.4 Reference to other sections

Reference to other sections: See section 8. See section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling: Avoid dust formation. Do not breathe dust. Provide appropriate local exhaust to minimize dust formation. Do not use compressed air.

Take precautionary measures against static discharges. Provide adequate precautions, such as electrical grounding and bonding, or inert atmospheres. Grounding of equipment and conveying systems may be required under certain conditions. Safe work practices include the elimination of potential ignition sources in proximity to carbon black dust; good housekeeping to avoid accumulations of dust on all surfaces; appropriate exhaust ventilation design and maintenance to control airborne dust

levels to below the applicable occupational exposure limit. If hot work is required, the immediate work area must be cleared of carbon black dust.

General hygiene considerations: Handle in accordance with good industrial hygiene and safety practices.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions: Keep in a dry, cool, and well-ventilated location. Store away from heat, ignition sources, and strong oxidizers.

Carbon black is not classifiable as a Division 4.2 self-heating substance under the UN test criteria. However, current UN criteria for determining if a substance is self-heating is volume dependent. This classification may not be appropriate for large volume storage container.

Before entering vessels and confined spaces containing carbon black, test for adequate oxygen, flammable gases and potential toxic air contaminants. Do not allow dust to accumulate on surfaces.

Incompatible materials: Strong oxidizers.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Exposure guidelines: Representative occupational exposure limits currently available for carbon black (CAS number: 1333-86-4).

Country	Concentration, mg/m3
Australia	3.0, TWA, inhalable

8.2 Exposure controls

Engineering controls: Use process enclosures and/or exhaust ventilation to keep airborne dust concentrations below the occupational exposure limit.

Personal Protective Equipment (PPE)

Respiratory: Approved air purifying respirator (APR) should be used where airborne dust concentrations are expected to exceed occupational exposure limits. Use a positive-pressure, air supplied respirator if there is any potential for uncontrolled release, exposure levels are not known, or in circumstances where APRs may not provide adequate protection.

When respiratory protection is required to minimize exposures to carbon black, programs should follow the requirements of the appropriate governing body for the country, province or state. Selected references to respiratory protection standards are provided below:

- OSHA 29CFR1910.134, Respiratory Protection
- CR592 Guidelines for Selection and Use of Respiratory Protective Devices (CEN)
- German/European Standard DIN/EN 143, Respiratory Protective Devices for Dusty Materials (CEN)

Hand protection: Wear protective gloves. Use a barrier cream. Wash hands and skin with mild soap and water.

Eye/face protection: Wear safety glasses or goggles.

Skin protection:	Wear general protective clothing to minimize skin contact. Wash clothing daily. Work clothes should not be taken home.
Other:	Emergency eyewash and safety showers should be in close proximity. Wash hands and face thoroughly with mild soap before eating or drinking.

Environmental exposure controls: in accordance with all local legislation and permit requirements.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance:	powder or pellet
Color:	black
Odor:	odorless
Odor threshold:	not applicable
Melting point/freezing point:	not applicable
Boiling point/range:	not applicable
Vapor pressure:	not applicable
Vapor Density:	not applicable
Oxidizing properties:	not applicable
Flash Point:	not applicable
Flammability:	not flammable
Explosive properties:	Dust may form explosible mixture in air
Explosion limits (air):	
Upper:	not available
Lower:	50 g/m^3 (dust)
Evaporation rate:	not applicable
Density: (20ºC):	1.7 – 1.9 g/cm^3
Bulk density:	1.25-40 lb/ft^3, 20-640 kg/m^3
Pellets:	200-680 kg/m^3
Powder (fluffy):	20-380 kg/m^3
Solubility (in Water):	insoluble
pH value: (ASTM 1512):	4-11 [50 g/l water, 68ºF (20ºC)]
Partition coefficient (n-octanol/water):	not applicable
Viscosity:	not applicable
Decomposition temperature:	not applicable
Auto-ignition temperature:	>140ºC
Minimum Ignition temperature:	>500ºC (BAM Furnace)(VDI 2263) >315ºC (Godberg-Greenwald Furnace)(VDI 2263)
Minimum ignition energy:	>10,000 mJ (VDI 2263)
Ignition energy:	not available
Maximum absolute explosion pressure:	10 bar (VDI 2263)
Maximum rate of pressure rise:	30-400 bar/sec (VDI 2263 and ASTM E1226-88)
Burn Velocity:	> 45 seconds (not classified as “highly flammable” or “easily ignitable”)
Kst Value:	not available
Dust explosion classification:	ST1
Decomposition temperature:	not applicable

9.2 Other information

Not available

SECTION 10: Stability and reactivity

10.1 Reactivity

Reactivity: May react exothermically upon contact with strong oxidizers.

10.2 Chemical stability

Stability: Stable under normal ambient conditions.

Explosion data

Sensitivity to mechanical impact: Not sensitive to mechanical impact

Sensitivity to static discharge: Dust may form explosible mixture in air. Avoid dust formation. Do not create a dust cloud. Take precautionary measures against static discharges. Ensure all equipment is earthed/grounded before beginning transfer operation.

10.3 Possibility of hazardous reactions

Hazardous polymerization: Does not occur.

Possibility of hazardous reactions: None under normal conditions.

10.4 Conditions to avoid

Conditions to avoid: Avoid high temperatures >400°C (>752°F) and sources of ignition.

10.5 Incompatible materials

Incompatible materials: Strong oxidizers.

10.6 Hazardous decomposition products

Hazardous decomposition products: Carbon monoxide, carbon dioxide, organic products of combustion, oxides of sulfur.

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute Toxicity:

Oral LD50: LD_{50} (rat) > 8000 mg/kg. (Equivalent to OECD TG 401)

Inhalation LD50: No data available

Dermal LD50: No data available

Skin corrosion/irritation: Rabbit: not irritating. (Equivalent to OECD TG 404)
Edema = 0 (max. attainable irritation score: 4)
Erythema = 0 (max. attainable irritation score: 4)
Assessment: Not irritating to skin.

Serious eye damage/irritation: Rabbit: not irritating. (OECD TG 405)
Cornea: 0 (max. attainable irritation score: 4)
Iris: 0 (max. attainable irritation score: 2)
Conjunctivae: 0 (max. attainable irritation score: 3)
Chemosis: 0 (max. attainable irritation score: 4)
Assessment: Not irritating to the eyes.

Sensitization: Guinea pig skin (Buehler Test): Not sensitizing (OECD TG 406)
Assessment: Not sensitizing in animals.
No cases of sensitization in humans have been reported.

Germ cell mutagenicity: *In vitro:* Carbon black is not suitable to be tested directly in bacterial (Ames test) and other *in vitro* systems because of its insolubility. However, when organic solvent extracts of carbon black have been tested, results showed no

mutagenic effects. Organic solvent extracts of carbon black can contain traces of polycyclic aromatic hydrocarbons (PAHs). A study to examine the bioavailability of these PAHs showed that they are very tightly bound to carbon black and are not bioavailable (Borm, 2005).

In vivo: In an experimental investigation, mutational changes in the *hprt* ene were reported in alveolar epithelial cells in the rat following inhalation exposure to carbon black (Driscoll*,* 1997). This observation is considered to be rat-specific and a consequence of "lung overload," which leads to chronic inflammation and release of reactive oxygen species. This is considered to be a secondary genotoxic effect and, thus, carbon black itself would not be considered to be mutagenic.

Assessment: *In vivo* mutagenicity in rats occurs by mechanisms secondary to a threshold effect and is a consequence of "lung overload," which leads to chronic inflammation and the release of genotoxic oxygen species. This mechanism is considered to be a secondary genotoxic effect and, thus, carbon black itself would not be considered to be mutagenic.

Carcinogenicity:

Animal toxicity

Rat, oral, duration 2 years.
Effect: no tumors.

Mouse, oral, duration 2 years.
Effect: no tumors.

Mouse, dermal, duration 18 months.
Effect: no skin tumors.

Rat, inhalation, duration 2 years.
Target organ: lungs.
Effect: inflammation, fibrosis, tumors.

Note: Tumors in the rat lung are considered to be related to "lung overload" rather than to a specific chemical effect of carbon black itself in the lung. These effects in rats have been reported in many studies on other poorly soluble inorganic particles and appear to be rat specific (ILSI, 2000). Tumors have not been observed in other species (i.e., mouse and hamster) for carbon black or other poorly soluble particles under similar circumstances and study conditions.

Mortality studies (human data)

A study on carbon black production workers in the UK (Sorahan, 2001) found an increased risk of lung cancer in two of the five plants studied; however, the increase was not related to the dose of carbon black. Thus, the authors did not consider the increased risk in lung cancer to be due to carbon black exposure. A German study of carbon black workers at one plant (Morfeld, 2006; Buechte, 2006) found a similar increase in lung cancer risk but, like the Sorahan, 2001 (UK study), found no association with carbon black exposure. A large US study of 18 plants showed a reduction in lung cancer risk in carbon black production workers (Dell*,* 2006). Based upon these studies, the February 2006 Working Group at the International Agency for Research on Cancer (IARC) concluded that the human evidence for carcinogenicity was *inadequate* (IARC, 2010).

Since the IARC evaluation of carbon black, Sorahan and Harrington (2007) have re-analyzed the UK study data using an alternative exposure hypothesis and found a positive association with carbon black exposure in two of the five plants. The same exposure hypothesis was applied by Morfeld and

McCunney (2009) to the German cohort; in contrast, they found no association between carbon black exposure and lung cancer risk and, thus, no support for the alternative exposure hypothesis used by Sorahan and Harrington.

Overall, as a result of these detailed investigations, no causative link between carbon black exposure and cancer risk in humans has been demonstrated.

IARC cancer classification

In 2006 IARC re-affirmed its 1995 finding that there is *"inadequate evidence"* from human health studies to assess whether carbon black causes cancer in humans. IARC concluded that there is *"sufficient evidence*" in experimental animal studies for the carcinogenicity of carbon black. IARC's overall evaluation is that carbon black is *"possibly carcinogenic to humans (Group 2B)".* This conclusion was based on IARC's guidelines, which generally require such a classification if one species exhibits carcinogenicity in two or more animal studies (IARC, 2010).

Solvent extracts of carbon black were used in one study of rats in which skin tumors were found after dermal application and several studies of mice in which sarcomas were found following subcutaneous injection. IARC concluded that there was *"sufficient evidence"* that carbon black extracts can cause cancer in animals (Group 2B).

ACGIH cancer classification

Confirmed Animal Carcinogen with Unknown Relevance to Humans (Category A3 Carcinogen).

Assessment: Applying the guidelines of self-classification under the Globally Harmonized System of Classification and Labeling of Chemicals, carbon black is not classified as a carcinogen. Lung tumors are induced in rats as a result of repeated exposure to inert, poorly soluble particles like carbon black and other poorly soluble particles. Rat tumors are a result of a secondary non-genotoxic mechanism associated with the phenomenon of lung overload. This is a species-specific mechanism that has questionable relevance for classification in humans. In support of this opinion, the CLP Guidance for Specific Target Organ Toxicity – Repeated Exposure (STOT-RE), cites lung overload under mechanisms not relevant to humans. Human health studies show that exposure to carbon black does not increase the risk of carcinogenicity.

Reproductive and developmental toxicity: Assessment: No effects on reproductive organs or fetal development have been reported in long-term repeated dose toxicity studies in animals.

Specific target organ toxicity – single exposure (STOT-SE): Assessment: Based on available data, specific target organ toxicity is not expected after single oral, single inhalation, or single dermal exposure.

Specific target organ toxicity – repeated exposure (STOT-RE):

Animal toxicity

Repeated dose toxicity: inhalation (rat), 90 days, No Observed Adverse Effect Concentration (NOAEC) = 1.1 mg/m^3 (respirable)

Target organ/effects at higher doses are lung inflammation, hyperplasia, and fibrosis.

Repeated dose toxicity: oral (mouse), 2 yrs, No Observed Effect Level (NOEL) = 137 mg/kg (body wt.)

Repeated dose toxicity: oral (rat), 2 yrs, NOEL = 52 mg/kg (body wt.)

Although carbon black produces pulmonary irritation, cellular proliferation, fibrosis, and lung tumors in the rat under conditions of lung overload, there is evidence to demonstrate that this response is principally a species-specific response that is not relevant to humans.

Morbidity studies (human data)
Results of epidemiological studies of carbon black production workers suggest that cumulative exposure to carbon black may result in small, non-clinical decrements in lung function. A U.S. respiratory morbidity study suggested a 27 ml decline in FEV_1 from a 1 mg/m^3 8 hour TWA daily (inhalable fraction) exposure over a 40-year period (Harber, 2003). An earlier European investigation suggested that exposure to 1 mg/m^3 (inhalable fraction) of carbon black over a 40-year working lifetime would result in a 48 ml decline in FEV_1 (Gardiner, 2001). However, the estimates from both studies were only of borderline statistical significance. Normal age-related decline over a similar period of time would be approximately 1200 ml.

In the U.S. study, 9% of the highest non-smokers exposure group (in contrast to 5% of the unexposed group) reported symptoms consistent with chronic bronchitis. In the European study, methodological limitations in the administration of the questionnaire limit the conclusions that can be drawn about reported symptoms. This study, however, indicated a link between carbon black and small opacities on chest films, with negligible effects on lung function.

Assessment:

Inhalation - Applying the guidelines of self-classification under GHS, carbon black is not classified under STOT-RE for effects on the lung. Classification is not warranted on the basis of the unique response of rats resulting from "lung overload" following exposure to poorly soluble particles such as carbon black. The pattern of pulmonary effects in the rat, such as inflammation and fibrotic responses, are not observed in other rodent species, non-human primates, or humans under similar exposure conditions. Lung overload does not appear to be relevant for human health. Overall, the epidemiological evidence from well-conducted investigations has shown no causative link between carbon black exposure and the risk of non-malignant respiratory disease in humans. A STOT-RE classification for carbon black after repeated inhalation exposure is not warranted.

Oral: Based on available data, specific target organ toxicity is not expected after repeated oral exposure.

Dermal: Based on available data and the chemical-physical properties (insolubility, low absorption potential), specific target organ toxicity is not expected after repeated dermal exposure.

Aspiration hazard: Assessment: Based on industrial experience and the available data, no aspiration hazard is expected.

SECTION 12: Ecological information

12.1 Toxicity

Aquatic toxicity:

Acute fish toxicity:	LC0 (96 h) 1000mg/l, Species: *Brachydanio rerio* (zebrafish), Method: OECD Guideline 203
Acute invertebrate toxicity:	EC50 (24 h) > 5600 mg/l, Species: *Daphnia magna* (waterflea), Method: OECD Guideline 202

Acute algae toxicity:	EC50 (72 h) >10,000 mg/l, NOEC 10,000 mg/l, Species: *Scenedesmus subspicatus*, Method: OECD Guideline 201
Activated sludge:	EC0 (3 h) > 400 mg/l, EC10 (3h): ca. 800 mg/l, Method: DEV L3 (TTC test)

12.2 Persistence and degradability
Not soluble in water. Expected to remain on soil surface. Not expected to degrade.

12.3 Bioaccumulative potential
Not expected because of the physicochemical properties of the substance.

12.4 Mobility in soil
Not expected to migrate. Insoluble.

12.5 Results of PBT and vPvB assessment
Carbon black is not a PBT or a vPvB.

12.6 Other adverse effects
Not available.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product disposal: Product should be disposed of in accordance with the regulations issued by the appropriate federal, provincial, state, and local authorities.

Container/Packaging disposal: Empty packaging must be disposed of in accordance with national and local laws.

SECTION 14: Transport information

The International Carbon Black Association organized the testing of seven ASTM reference carbon blacks according to the UN method, Self-Heating Solids. All seven reference carbon blacks were found to be "Not a self-heating substance of Division 4.2." The same carbon blacks were tested according to the UN method, Readily Combustible Solids and found to be "Not a readily combustible solid of Division 4.1;" under current UN Recommendations on the Transport of Dangerous Goods.

The following organizations do not classify carbon black as a "hazardous cargo" if it is "carbon, non-activated, mineral origin." Birla Carbon's carbon black products meet this definition.

	DOT	**IMDG**	**RID**	**ADR**	**ICAO (air)**	**IATA**
14.1	UN/ID No		Not regulated			
14.2	Proper shipping name		Not regulated			
14.3	Hazard class		Not regulated			
14.4	Packing group		Not regulated			

SECTION 15: Regulatory information

15.1 Classification

Australia: Not a hazardous substance or mixture according to the Globally Harmonized System (GHS) Rev. 3 referred to in the Australia Model Work Health and Safety Regulation (WHS).

International Inventories:

Carbon black, CAS number 1333-86-4, appears on the following inventories:

Australia:	AICS
Canada:	DSL
China:	IECSC
Europe (EU):	EINECS (EINECS-RN: 215-609-9)
Japan:	ENCS
Korea:	KECI
Philippines:	PICCS
Taiwan:	TCSI
New Zealand:	NZIoC
USA:	TSCA

SECTION 16: Other Information

Contact Information

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References:

Borm, P.J.A., Cakmak, G., Jermann, E., Weishaupt C., Kempers, P., van Schooten,FJ., Oberdorster, G., Schins, RP. (2005) Formation of PAH-DNA adducts after in-vivo and vitro exposure of rats and lung cell to different commercial carbon blacks. Tox.Appl. Pharm. 1:205(2):157-67.

Buechte, S, Morfeld, P, Wellmann, J, Bolm-Audorff, U, McCunney, R, Piekarski, C. (2006) Lung cancer mortality and carbon black exposure – A nested case-control study at a German carbon black production plant. J.Occup. Env.Med. 12: 1242-1252.

Dell, L, Mundt, K, Luipold, R, Nunes, A, Cohen, L, Heidenreich, M, Bachand, A. (2006) A cohort mortality study of employees in the United States carbon black industry. J.Occup. Env. Med. 48(12): 1219-1229.

Driscoll KE, Deyo LC, Carter JM, Howard BW, Hassenbein DG and Bertram TA (1997) Effects of particle exposure and particle-elicited inflammatory cells on mutation in rat alveolar epithelial cells. Carcinogenesis 18(2) 423-430.

Gardiner K, van Tongeren M, Harrington M. (2001) Respiratory health effects from exposure to carbon black: Results of the phase 2 and 3 cross sectional studies in the European carbon black manufacturing industry. Occup. Env. Med. 58: 496-503.

Harber P, Muranko H, Solis S, Torossian A, Merz B. (2003) Effect of carbon black exposure on respiratory function and symptoms. J. Occup. Env. Med. 45: 144-55.

ILSI Risk Science Institute Workshop: The Relevance of the Rat Lung Response to Particle to Particle Overload for Human Risk Assessment. Inh. Toxicol. 12:1-17 (2000).

International Agency for Research on Cancer: IARC Monographs on the Evaluation of Carcinogenic Risks to Humans (2010), Vol. 93, February 1-14, 2006, Carbon Black, Titanium Dioxide, and Talc. Lyon, France.

Morfeld P, Büchte SF, Wellmann J, McCunney RJ, Piekarski C (2006). Lung cancer mortality and carbon black exposure: Cox regression analysis of a cohort from a German carbon black production plant. J. Occup.Env.Med.48(12):1230-1241.

Morfeld P and McCunney RJ, (2009). Carbon Black and lung cancer testing a novel exposure metric by multi-model inference. Am. J. Ind. Med. 52: 890-899.

Sorahan T, Hamilton L, van Tongeren M, Gardiner K, Harrington JM (2001). A cohort mortality study of U.K. carbon black workers, 1951-1996. Am. J. Ind. Med. 39(2):158-170.

Sorahan T, Harrington JM (2007) A ‘‘Lugged’’ Analysis of Lung Cancer Risks in UK Carbon Black Production Workers, 1951–2004. Am. J. Ind. Med. 50, 555–564.

The data and information presented herein corresponds to the present state of our knowledge and experience and is intended to describe our product with respect to possible occupational health and safety concerns. The user of this product has sole responsibility to determine the suitability of the product for any use and manner of use intended, and for determining the regulations applicable to such use in the relevant jurisdiction. This SDS is updated on a periodic basis in accordance with applicable health and safety standards.

Global Manager – Product Stewardship
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