[Report]

The Respiratory Health of Carbon Black Workers — Differences between Polish, West European and American Scientific Reports —

Ryszard SZOZDA

Carbon Black Factory "Carbochem", Gliwice, Poland

Abstract : Carbon black is used as a reinforcing agent and pigment. It is often equated with environmental soots but actually differs from the general class of soots in terms of chemical, physical and biological properties. In Poland, epidemiological surveys indicate a possible existence of pulmonary hazards among the workers exposed to carbon black, although further surveys are now under way. In West European countries, the results of one survey do not support this, but the next one will be completed after 6 years. In the United States, results indicate that exposure to carbon black in the workplace does not increase the risks of workers for circulatory, respiratory and malignant morbidities. Further evaluation of the effect of carbon black on human health must be continued.

Key words : carbon black, pulmonary diseases, epidemiology.

Carbon black is used in rubber, plastic, printing and plant industries as a reinforcing agent and pigment. It is widely used in the rubber industries, that is, 90% of the world production, including 65% for tire manufacturing. Carbon black was one of the earliest synthetic pigments, as demonstrated by its use in prehistoric cave wall painting, ancient Egyptian and Indian paints and lacquers and also for Chinese ink. The Chinese commercial products of carbon black were produced by burning purified animal oils or vegetable oils in small lamps and collecting the soot. Chinese ink was exported to Japan at least fifteen hundred years ago [4].

During the last sixty years, a wide range of applications have been found for carbon black. Though differing in some details, almost all carbon black production involves the thermal decomposition of a vapor-phase hydrocarbon to produce a highly purified carbon aerosol from which the particles are separated and further processed to the final products. Flue gas composition depends on the feedstock and reactor conditions. The organic impurities adsorbing the

carbon black are affected primarily by the reactor conditions, especially its thermal history [5].

Carbon black is often equated with environmental soots, but in fact differs from the general class of soots in physico-chemical properties. Carbon black are highly purified colloidal carbons, usually containing less than several tenth percent of extractable organic materials and less than one percent of non-volatile inorganic compounds (ash). On the other hand, soots are uncontrolled by-products of the pyrolysis containing a variety of other carbon sources. Soots are mixtures of various forms of particulate carbon, organic tar, resins and refractory inorganic materials [3]. The carcinogenicity of carbon black is due to the association of polycyclic aromatic hydrocarbons (PAH), such as benzo(a)pyrene. Many reports have described lung abnormalities in carbon black workers which are attributed to the dust. When the dust was inhaled, it penetrated to all parts of the lung. However, PAH's involving benzo(a)pyrene have not been detectable at least by the chemical methods that do not use organic solvents. This finding can be explained by the very high adsorption of PAH's on carbon black particles and these chemical carcinogens are not extractable without the use of organic solvents. The studies expecting possible elution of PAH into the tissue fluid from carbon black particles accumulating in the lung tissues did result in any definite conclusions [8, 9].

Poland

A health survey of workers in one of two carbon black factories in Poland was organized after discussion among representatives of management. The data were collected by using a questionnaire, expiratory sirogram, physical examination and by obtaining a chest radiograph. In the first part of the study, which dealt with the respiratory health of carbon black workers, results did not support the existence of pulmonary disease hazards among workers exposed to carbon black. The evidence from this survey showed that smoking is the principal factor affecting the lung function of carbon black workers [10].

In the second part of this study, I discovered that carbon dust increases the prevalence of respiratory symptoms, such as chronic bronchitis and obstructive dysfunction, in exposed carbon black workers. The difference between exposed workers and the control group was statistically significant. Also, obstructive dysfunction was found to be common in the exposed group. In conclusion, I would have to say that the results support the existence of pulmonary disease hazards among workers exposed to carbon black [11]. This survey will have to be continued to obtain a more reliable conclusion.

West European Countries

A survey of workers in 18 plants in west European countries and one in the United Kingdom was carried out. A cross-sectionary study of the respiratory health of carbon black workers in eight countries has been reported. According to the reports, carbon black dust increases the prevalence of respiratory symptoms in the exposed group of carbon black workers. However, evidence from this survey indicated that smoking was the principal factor affecting the lung function of carbon black workers, while the exposure to carbon black dust alone had less effect than that expected from a nuisance dust. There was no evidence of any increases of radiological abnormality in the carbon black workers surveyed [1].

Another study undertook to investigate the respiratory morbidity of individuals occupationally exposed to carbon black in factories. The study was designed by and is being coordinated with the Institute of Occupational Health, University of Birmingham. There are no conclusions regarding the connection between carbon black and the respiratory health of workers at present, because the two phases of the study will not be finished until six years after it was begun.

United States

In 1979, five of the seven carbon black factories in the United States instituted physical examination programs for all employees. These programs included detailed and complete physical examinations, standard laboratory tests, chest X rays, and pulmonary function tests for workers exposed to carbon black dust. This cross-sectional study did not detect an association between the total dust exposure in the workplace and pulmonary dysfunction in the group of carbon black workers. Confirmation of this finding awaits the results of long-term studies which are currently in progress [6].

Another survey in the United States was taken recently. The results of this study did not support the view that total dust exposures in carbon black contribute to the development in workers of the circulatory, respiratory and malignant diseases examined. In summary, this case-control study has demonstrated that carbon black workers who suffered from selected circulatory, respiratory and malignant diseases did not experience heavier exposures to carbon black dust in the workplace than did matched control workers who presumably were free of these diseases. The results of these studies indicate that exposure to carbon black in the workplace does not increase the worker's risks of circulatory, respiratory and malignant morbidity [7].

In conclusion, the results of pertinent industrial hygiene surveys and clinical and epidemiological studies of occupationally exposed workers in Poland, Western European countries and in the United States of America are summarized. Further surveys will be required before any conclusions on the risk of carbon black can be made.

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カーボンブラック作業者の呼吸器疾患
— ポーランド，西欧，および米国の現状 —

リザード・ソーダ

カーボンブラック製造所 “カルボケム”，グリワイス・ポーランド

要 旨： カーボンブラックは補強剤や色素として広く用いられている。しばしば、「すす」と同じものと誤解されるが、物理化学的性質は煤煙の「すす」と、カーボンブラックは全く異なっている。ポーランドにおける疫学的調査では、カーボンブラックの曝露を受けている作業者の呼吸器系の障害が起こる可能性を示唆する結果が得られているが、さらに調査が進められている。西欧諸国での調査ではそのような可能性を支持する結果は得られていないが、結論が出るまでにあと6年間の調査が必要である。一方、米国の調査では、カーボンブラックの作業現場での曝露で、循環器系、呼吸器系の疾患、あるいは悪性腫瘍のリスクは増加しないと報告されている。カーボンブラックのヒトの健康に対する影響の評価はさらに継続する必要がある。

J UOEH (産業医大誌) 16 (1): 91-95 (1994)