**COMMITTEES ON TOXICITY, MUTAGENICITY AND CARCINOGENICITY OF CHEMICALS IN FOOD, CONSUMER PRODUCTS AND THE ENVIRONMENT**


# STATEMENT ON 2-CHLOROBENZYLIDENE MALONONITRILE (CS) AND CS SPRAY

## Introduction

1. The advice of the Committees on Toxicity, Mutagenicity and Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COT, COM, and COC), on 2-chlorobenzylidene malononitrile (CS), specifically in the context of the use of CS spray as a chemical incapacitant, was sought by the Department of Health, with the support of the Home Office.

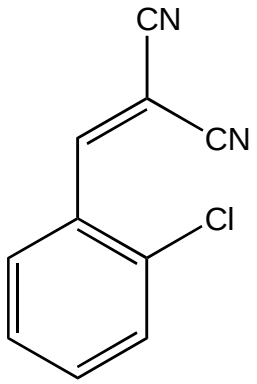
2. CS spray has now been used by some police forces in England and Wales since March 1, 1996 when it was introduced for a trial period which was followed by approval in September 1996. Although the use of CS as an aerosol or 'smoke' was reviewed following its use in Londonderry in 1969,[1,2] the spray itself has not been subjected to scrutiny by independent expert advisory committees. It was for this reason, and because of the potential public health concerns, that the Department of Health was of the opinion that such a referral was appropriate.

3. This statement incorporates the conclusions of each of the three Committees and is divided into sections concerned with a) the physical and chemical properties of the spray, b) the toxicological data on the compound CS, c) the toxicological data on the solvent, methyl isobutyl ketone (MIBK), and d) the toxicological data on CS spray. The COT considered toxicological data on CS itself and the solvent MIBK itself and then the very limited animal and human data on the combination, CS spray. Professor K.E. Donaldson of Napier University assisted the Committee in its deliberation and Dr V.S.G. Murray and her colleagues from the Chemical Incident Response Service (CIRS) and the National Poisons Information Service (NPIS), London Centre described cases of putative toxic effects of CS spray reported to their service.

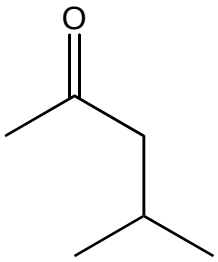
## The nature of CS spray and its components

4. The CS spray used by police forces in the UK consists of a 5% (w/v) solution of CS in MIBK, comprising 1.5 grams (g) of CS dissolved in a total volume of 30 millilitres (ml), contained in a canister with nitrogen as a propellant. The chemical structures of CS and MIBK are given in the Figure below.

**Figure**




2-Chlorobenzylidene malononitrile (CS)




Methyl isobutyl ketone (MIBK)

## Exposure to CS spray

5. The COT noted that, although there are reports and studies which describe the effects of CS spray on humans, these do not provide data in respect of individuals who have been sprayed which allow any estimation of their exposure to the constituent chemicals. The guidelines for the use of CS spray that have been provided to police forces for the training of officers were available[3] but, in the absence of quantitative evidence relating to operational use, the Committee was unable to estimate exposure in the field.

6. However, to address this question the Police Scientific Development Branch (PSDB) of the Home Office carried out a study of 500 canisters that had been used operationally in the UK by police officers in the course of arrests of individuals. The Committee has been informed that it is standard practice to replace a canister after it has been used once. By comparing the weights of the used canisters with the mean weight of unused canisters it was possible to estimate the quantities of CS spray that had been used during each incident. At the maximum flow rate permitted in the specifications, 10% of the canisters had been discharged for a total calculated period of more than 3 seconds and had weights corresponding to the release of between 12.0 and 23.7 g of the CS solution in MIBK. The peak of the exposure distribution corresponded to the release of 4 to 6 grams of the solution of CS in MIBK, of which 0.28 to 0.35 g is calculated to have been CS.[4]

7. The nature of the toxic effects of the spray will depend upon the extent to which exposure occurs to the eyes, to the skin and via inhalation or ingestion. The mass and size of the droplets of the CS solution in MIBK produced during spraying will determine how far the droplets can penetrate into the respiratory tract. In response to the COT's enquiries about the physical properties of the spray released from the canisters, the PSDB commissioned a study, undertaken by AEA Technology, to address the question of the size distribution of droplets produced under conditions simulating operational use.

8. The results of this study indicate that, when the CS spray is used at distances of 2 to 3 metres from a detector, the median diameter of the spray particles is between 417 to 441 micrometres (µm). There are, however, some particles with diameters of less than 100 µm and a few with diameters of less than 50 µm. When the spray was used at distances of less than 0.1 m, (a shorter distance than that recommended for operational use), the proportion of the smaller droplets decreased. When the spray was allowed to impinge on, and be scattered back from, a solid target the proportion of smaller diameter droplets increased. In a further study with 5 canisters of CS spray in which the diameter of the smaller particles was measured, none were found to have diameters of less than 28 µm.[5]

9. The Committee was of the view that, although the CS canisters release, for the most part, a coarse spray, there is a proportion of droplets with diameters of less than 100 µm which, in the event of full discharge of the can, could transport a maximum of 20 mg of the spray solution into the upper respiratory tract the smallest droplets of which (diameter 28 to 50 µm), could reach the large- and medium-sized airways of the lung. This proportion will be increased if the spray is scattered from any nearby surface. Since these are the airways that are affected in bronchial asthma, it is possible that an asthmatic attack could occur in susceptible individuals. It was also recognised that the increased rate and depth of respiration occurring in an individual under stress might, in addition, result in a greater dose of the CS spray being inhaled.

10. In a separate study with CS canisters the vapour concentration of the solvent MIBK was measured at 6 positions placed either as close as could be achieved or up to 0.5 m from a target. The target was sprayed from a distance of 2.0 m for periods of 1 or 3 seconds or until the canister was empty. The resultant MIBK vapour concentration at each position was then measured at one second intervals for a period of 15 minutes. In these trials the Short Term Exposure Limit (STEL)* for MIBK of 100 ppm time-averaged over a 15 minute reference period[6] was exceeded on four out of eighteen occasions. However, static air conditions were used in these trials in order to achieve a greater reproducibility,[4] such conditions would reduce dispersion and increase average measured concentrations.

11. Because of the nature of this trial, and the differences in circumstances from operational use where static air conditions would be unlikely, the Committee felt that these results probably did not represent a cause for concern, provided that the spray is used in

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* Short Term Exposure Limit (STEL): An occupational exposure limit defining a level of exposure over a 15 minute reference period which should never be exceeded.[6] Such values are typically set to protect workers against effects that occur rapidly after exposure eg irritation of the eyes, nose and throat.

accordance with the operational guidelines.

## Toxicity of CS

12. Most of the data on the toxicity of CS derive from studies which have used either CS aerosols or pyrotechnically-generated 'smokes'. In both cases respirable particles were produced. Data have been obtained on the size of droplets resulting from the use of CS dissolved in an organic solvent and delivered in the form of a spray; these are discussed in paragraphs 7 to 9 above.

### *Metabolism*

13. Studies of the metabolism of CS have been conducted on the compound itself and not in the form in which it would be used as an incapacitating agent by police officers. It is readily hydrolysed in aqueous mixtures[7,8] and reacts readily with plasma proteins and glutathione *in vitro* and *in vivo*.[9,10] It undergoes rapid metabolism and chemical breakdown *in vitro* and *in vivo*, initially to 2-chlorobenzaldehyde and malononitrile, each of these then undergo further rapid reactions. The half lives ($t_{½}$) of CS and the metabolites, 2-chlorobenzaldehyde and 2-chlorobenzylmalononitrile in one *in vivo* experiment involving the administration of compounds by intra-arterial injection into cats were 5.4, 4.5 and 9.5 seconds respectively.[11] After oral administration CS is metabolised and eliminated largely (*circa* 70%) via the urine as 2-chlorohippuric acid and 2-chlorobenzoic acid.[12] Other metabolites have been identified but there is no evidence of dechlorination. It was noted however that the available data were not as comprehensive as would have been obtained if modern techniques had been used. In addition, no data were available on the kinetics of CS administered as a solution in MIBK.

### *Experimental studies in animals*

14. The acute toxicity of CS following exposure via inhalation is characterised by sensory irritancy followed by prompt recovery. Acute studies in rodents and guinea pigs using pyrotechnically-generated CS smokes indicated that short term exposure (10 to 20 minutes) to concentrations of CS of around 4 grams/metre$^3$ (g/m$^3$), or longer exposure (several hours) to levels of around 30 to 40 mg/m$^3$, resulted in deaths. Death was due to severe lung damage (comprising haemorrhages and oedema).[13] Animals that survived showed no pathological abnormalities when examined 14 days later.

15. Studies to investigate skin irritancy in rats, rabbits and guinea pigs indicated that a 12.5% (w/v) solution of CS in corn oil or acetone applied for 6 hours without occlusion produced mild skin irritation.[7] No conclusions can be drawn with regard to its potential to induce skin sensitisation from the two animal studies available due to limitations in the methodology used.[14,15] There are, however, some data in humans to indicate that CS can provoke skin sensitisation (see paragraph 30).

16. The eye irritancy of CS has been shown to be dependent upon the solvent used. A 5% (w/v) solution in PEG-300 (polyethylene glycol) produced severe irritant effects in the rabbit (mild or moderate keratitis lasting for 2 weeks or more after a single application) whereas a 10% (w/v) solution in trichloroethane produced some conjunctivitis but no corneal

damage and no effects were seen after 7 days.[16,17] Results of eye irritancy studies in rabbits using a 7% (w/v) solution in MIBK are given in paragraph 44; signs of severe irritation were seen initially with recovery after 8 days.

17. Repeated dose inhalation studies involving exposure for 1 hour a day for 120 days, indicated a NOAEL* of about 30 mg CS/$m^3$ in a range of species (mice, rats, guinea-pigs).[18] At around 200 mg/$m^3$ in mice and guinea pigs, deaths of 23% and 48% respectively of the exposed animals occurred in the first month of the experiment.

## Mutagenicity

18. The mutagenicity data on CS were considered by the Committee on Mutagenicity of Chemicals in Food, Consumer Products and the Environment (COM). Their conclusions are given in the following paragraphs.

### In vitro *studies*

19. The mutagenicity of CS has been extensively studied *in vitro*. Negative results were obtained in *Salmonella* assays, but there were reservations regarding the suitability of the standard protocols used in these tests with respect to CS in view of its very short half life.[19-23] Positive results were noted in assays in V79 cells for gene mutation and also in the mouse lymphoma assay.[20,24,25] Positive results were documented also in metaphase analysis for clastogenicity in V79 and CHO cells.[20,26] In addition, CS has been shown to induce SCEs (Sister Chromatid Exchanges) in CHO cells.[20] These data indicate that CS has clastogenic potential.

20. There is evidence from *in vitro* studies to indicate that CS has aneugenic effects. It has been shown to interfere with the spindle machinery and cell division in mammalian cells resulting in C-mitosis and metaphase block.[27-32] CS has also been shown to induce micronuclei in mammalian cells *in vitro*.[25] These data suggest that CS has aneugenic potential.

21. The clastogenic effects seen appear to be due to CS itself, or an unknown short-lived intermediate.[26] The mechanism of aneugenicity appears to differ from the clastogenicity with 2-chlorobenzaldehyde being the important metabolite regarding aneugenicity but not in respect of clastogenicity.[29]

### In vivo *studies*

22. Negative results were consistently obtained in bone marrow or peripheral blood assays for micronuclei induction using high dose levels and both the oral and intraperitoneal routes.[23,33] (These assays are capable of detecting clastogens and aneugens if the active metabolite reaches the bone marrow.) It was noted that no data were available to indicate if adequate amounts of CS or short lived reactive metabolites reached the target organ. Data from DNA binding studies in the liver and kidney did not help in this regard as no relevant

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* No Observable Adverse Effect Level

analysis of tissues of initial contact (ie skin or nasal mucosa) were undertaken.[21] Studies using *Drosophila* (fruit flies) did not provide any meaningful data as the experimental design was unlikely to result in exposure of *Drosophila* to biologically active CS.[23] It was felt prudent for complete reassurance on the lack of mutagenic activity of CS *in vivo* to have data from a study to investigate genotoxicity to measure potential mutagenicity at a site of contact, for example in the nasal mucosa. However, some members of COM recognised that the design of such an animal study would be difficult both from practical and ethical standpoints and were of the opinion that these studies were not necessary.

## Carcinogenicity

23. The carcinogenicity data on CS were considered by the Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC). Their conclusions are given in the following paragraph.

24. The US National Toxicology Program carcinogenicity studies provide no evidence that CS had any carcinogenic effects in adequately conducted inhalation bioassays in rats or in mice following 2 year exposure at up to 0.75 mg/m$^3$ and 1.5 mg/m$^3$ respectively.[20] These data provide reassurance that CS does not have mutagenic activity *in vivo* at site of contact tissues, a concern raised by the COM. No further work relating to CS is therefore needed in this area.

## Reproductive toxicity

25. Developmental toxicity (teratogenicity) studies using the inhalation route and an aerosol of CS (1-2 µm mass median diameter) did not indicate any teratogenic or foetotoxic effects in rats or rabbits exposed to 60 mg/m$^3$ CS (5 minutes per day) on days 6 to 15 of pregnancy.[34] Similar results were obtained when CS was given by the intraperitoneal route at 20 mg/kg as a single dose on day 6, 8, 9, 10, 12 or 14 of pregnancy.

26. There were no data available relating to single or multigeneration reproductive toxicity studies.

## Effects in humans

27. Most of the data available relates to studies involving CS smoke or aerosol and exposure via inhalation. Aerosols were generated by thermal dispersion (particle size about 0.5 µm) or from a solution in methylene chloride (particle size about 1 µm). Studies on volunteers indicate that exposure to about 0.5 to 1 mg/m$^3$ CS for 90 minutes in an exposure chamber produced profuse tears (lachrymation), involuntary repeated closure of eyes (blepharospasm), a burning sensation in the mouth, nasal irritation and symptoms of tightness in the chest; in some cases difficulty in breathing was experienced, particularly upon initial exposure.[35,36] Subjects were able to tolerate exposure at these levels throughout

the 90 minute duration of this experiment. In general exposures of about 2.5 mg/$m^3$ could be tolerated only for a few minutes. These data relate to subjects not previously exposed to CS. There is evidence for the development of some tolerance if exposures are built up slowly with 7/8 (88%) subjects then being able to tolerate 2.5 mg/$m^3$ for 60 minutes.[36] Once exposure ceased all symptoms and signs, apart from headache, disappeared within a few minutes. No biologically significant effects were seen on respiratory function, blood chemistry nor in the pattern of electrocardiograms (ECG). However, the observation of effects on the ECG would be very dependent on the time after exposure at which they were measured and it is not clear from the published paper how long a delay occurred after exposure had ceased.[36] Dermal exposure of volunteers, by body drenching whilst only lightly clothed, with very dilute aqueous solutions of CS (up to 0.0005% w/v) resulted in marked transient skin and eye irritation.[37] During this period a rise in both systolic (30 to 59 mm Hg) and diastolic (15 to 30 mm Hg) blood pressures was noted which took 2 to 25 minutes to fall to within 10 mm Hg of the controls. This was not dose-related and was not exacerbated by exercise.

28. Data from volunteer studies and experience in use, both in the manufacture of CS and its use in riot control, indicate that CS itself is a skin irritant. Volunteers whose forearm skin was exposed to dry powder experienced a mild, transient skin reaction.[38] The effects were more pronounced if the powder was moistened, when erythema lasted for between 1 to 2 days. Studies have also been carried out on volunteers whose forearm skin was exposed to high concentrations of CS under simulated tropical conditions.[39] Marked irritant effects could be produced although there was much variability in response depending on the individual and on local conditions (heat and moisture). A high incidence of dermatitis on the arms and neck has been reported at the industrial site in the USA that manufactured CS in the past.[39] Occupational hygiene standards at this plant were poor, with airborne CS concentrations of levels up to 12 mg/$m^3$ (much greater than the Threshold Limit Value TLV* at the time of 0.4 mg/$m^3$).

29. Skin problems were common in individuals exposed to CS from grenades when these were used in Hong Kong during rioting at a Vietnamese detention camp, under circumstances where the rioters were not able to disperse.[40,41] A subsequent review of case records of 184 patients with symptoms consistent with CS exposure revealed a high incidence (52%) of skin problems including contact dermatitis and minor burns, most of which resolved within 2 weeks. Some of the skin injuries were caused by contact with hot canisters or grenades.

30. There is some evidence that CS can also produce skin sensitisation. At the CS manufacturing site referred to in paragraph 28, 8% (2/25) of the individuals who were patch tested with CS showed skin reactions consistent with allergic contact dermatitis.[39] There are also case reports of CS-induced allergic contact dermatitis in four individuals who were also exposed to CS from tear gas grenades.[42-44] There is, however, no information on the sensitisation potential of CS in solvent formulations.

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* Threshold Limit Value (TLV): Occupational exposure limit, for an 8 hour time weighted exposure, recommended by the American Conference of Government Industrial Hygienists in the USA.

31. Data on eye irritancy are available from studies in volunteers. Exposure of young male volunteers to 0.1 or 0.25% CS as a slurry in 0.5% polysorbate, either directly (0.25 ml drop) or as a spray (hand-held disperser from 15 feet), resulted in a severe pain response for a few minutes, profuse tears and redness of the conjuctiva for about 10 minutes.[45] Comparable effects were seen in volunteers exposed to up to 1% CS in an organic solvent (trioctyl phosphate) using identical methodology.[46] There was complete recovery after about 30 minutes. Similar effects were seen in volunteers exposed to CS powder (0.8 μm mass median diameter) at up to 6.7 mg/m$^3$ for 10 minutes.[47] There were no effects on visual acuity several minutes after exposure ceased. Data from experience in use indicates similar effects with transient pain, profuse tears and conjunctival reddening. There is no evidence from these studies of any permanent damage.

32. The question as to whether subjects being treated with neuroleptic drugs are likely to be more sensitive to CS spray has been raised.[48] There are no experimental data to allow any conclusions to be drawn on this aspect of the toxicity of CS.

33. The only data on the effects of repeated exposure to CS derived from case reports of workers occupationally exposed.[2] These do not indicate any effects other than local irritant effects seen after acute exposure, but no conclusions can be drawn from these very limited data.

**Toxicity of MIBK**

34. MIBK is readily absorbed and widely distributed in various tissues of rats and mice following oral or inhalation exposure.[49,50] The major metabolites in rodents are 4-hydroxy-4-methyl-2-pentanone (4-OHMIBK) and 4-methyl-2-pentanol (4-MPOL) which may be further conjugated, or metabolised and eliminated as carbon dioxide, or incorporated into tissues.[50,51] Data on elimination of MIBK are incomplete. Studies in humans suggest that absorbed MIBK is rapidly cleared from blood and that very little unchanged MIBK is eliminated in the urine.[52]

35. Studies using hens have indicated that MIBK has the potential to induce microsomal metabolism carried out by cytochrome P450 enzymes in the liver after repeated exposure for 3 months. MIBK would thereby potentiate the effects of other chemicals (including drugs) that undergo activation via cytochrome P450-mediated metabolism.[53] These data, however, derived from studies involving prolonged, repeated exposure and are not relevant to single exposure, as is the case in the use of CS spray in the field.

36. MIBK is of low acute toxicity in rats or mice both by inhalation (4 hour $LC_{50}$* circa 12 g/m$^3$) or by ingestion (oral $LD_{50}$# 2 to 5 g/kg b.w.).[54-56] Studies in rabbits to investigate skin irritancy using an occlusive dressing and 10 to 24 hour exposure resulted in minor transient effects, indicating that MIBK has a low skin irritant potential.[57,58] Repeated exposure

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* $LC_{50}$: Lethal concentration estimated to result in deaths of 50% of the exposed animals.

\# $LD_{50}$: Lethal dose estimated to result in deaths of 50% of the exposed animals.

produced drying and flaking of the skin due to the defatting action of MIBK. Eye irritancy studies in the rabbit using neat MIBK (0.1 ml) resulted in transient effects.[54] These results indicate that MIBK has low eye irritant potential.

37. Repeated dose (90-day) studies by inhalation showed effects on the liver and kidneys.[59] In mice the only effect seen, apart from lachrymation, at the top dose (4100 $mg/m^3$) was a small increase (11%) in liver weight, not accompanied by histopathological abnormalities. A similar effect was seen in the liver of rats. In addition, nephrotoxicity was seen in the proximal tubules of the rat kidney at concentrations of 1025 and 4100 $mg/m^3$ of MIBK. Nephrotoxicity was limited to the male rat and was associated with hyaline droplet deposition. It may have been due to binding to alpha-2 urinary microglobulin, a male rat specific protein; this mechanism is believed to be specific to the male rat.[60] The NOAEL was 205 $mg/m^3$ in the rat and 1025 $mg/m^3$ in the mouse.

38. In an unpublished 90-day oral study in the rat, histological evidence of kidney damage was reported at doses of 250 mg/kg and above, both in male and female animals. There was increased liver weight, not accompanied by histopathological damage, at 100 mg/kg.[61] The NOAEL for this study was estimated to be 50 mg/kg.

39. There is no evidence that MIBK or its major metabolite 4-OHMIBK have any genotoxic properties. Negative results were obtained with MIBK in the *Salmonella* assay, a metaphase analysis for clastogenicity in hepatocytes, a mouse lymphoma assay, an unscheduled DNA synthesis (UDS) assay in hepatocytes and also *in vivo* in a bone marrow micronucleus assay.[62,63] Negative results were obtained for the metabolite in the *Salmonella* assay and metaphase analysis in hepatocytes.[62]

40. The developmental toxicity (teratogenicity) of MIBK in rats and mice has been assessed following exposure between 300 and 3000 ppm by inhalation on gestation days 6-15.[64] Maternal toxicity and foetotoxicity were observed in both species at 3000 ppm, but not at 1000 ppm. Significant reductions in foetal weight and ossification in the rat at 300 ppm were probably related to litter sizes and were not treatment-related. Contrary to the statement in some reports (which have relied on secondary sources and not the original article), there was no evidence of teratogenicity in either species, even at the maternally toxic exposure concentration of 3000 ppm.

41. It was noted that no carcinogenicity bioassays nor any single or multigeneration reproductive toxicity studies have been carried out on MIBK.

42. The characteristic effects noted in humans relate to local irritant effects and non-specific central nervous system (CNS) effects (eg headache, nausea) at occupational exposures of about 100 ppm and above.[52,65,66] The odour threshold is low (0.4 ppm) and the irritant effects can be detected at about 2 ppm.[67]

## Data on the combination of CS and MIBK

43. The Committee noted the sparsity of data on the combination of CS dissolved in MIBK. There are no data available on the metabolism, kinetics, acute toxicity, or skin irritancy of CS when administered in MIBK as solvent.

44. The only experimental data specifically on this combination consist of a study on the eye irritancy of 7% CS in MIBK (w/v) in rabbits.[68] This indicated that spraying 7% CS directly into the eyes of rabbits from close range produced severe irritant effects, including a degree of corneal opacity, which had cleared by day 8 and was not followed by irreversible damage.

45. Information was available from experience arising from the use of the spray from studies carried out by NPIS London Centre and the CIRS.[69,70] These indicated that there were cases of dermatitis following the use of CS spray: the effects produced were noted 6 hours after the exposure. No longer term follow-up studies have been carried out. There are also case reports of marked dermatitis following the use of CS spray in France. The report describes eleven subjects of whom five had multiple exposures to CS. The authors considered that a direct irritant effect was responsible, although an allergic dermatitis could not be ruled out. It is not clear from the published information whether exposure was to CS in MIBK or to another formulation. In addition, no information is available on the ethnicity of the exposed individual who developed dermatitis.[71]

46. Literature searches did not reveal reports of serious eye damage caused by CS spray. Furthermore such cases were not identified as a consequence of exposure to CS spray in the data provided by NPIS London Centre.

## Conclusions

47. The Committee noted that there are considerable data available to assess the toxicity of CS itself, and to a lesser extent, the solvent MIBK itself. CS is a potent sensory irritant, particularly to the skin and the eyes. It is rapidly hydrolysed and therefore tissue exposure to CS itself is transient. Experience in use indicates that it is a skin irritant and there are some reports of skin sensitisation occurring. There are no concerns relating to the mutagenicity, carcinogenicity or teratogenicity of CS itself. The toxicity of the solvent MIBK is characterised by transient local irritant effects and central nervous system (CNS) effects (particularly headache, nausea) resulting from occupational exposures of about 100 ppm and above. Negative results were obtained in mutagenicity tests and there was no evidence of teratogenicity in developmental toxicity studies. There is no information from carcinogenicity or multigeneration reproductive toxicity assays.

48. There are very few data on the formulated material. A 7% (w/v) solution of CS in MIBK produced severe irritant effects in rabbit eyes followed by recovery in 8 days. This is consistent with the absence of evidence of serious permanent eye damage in humans. Experience in use indicates that it has skin irritant properties, and can cause dermatitis.

49. The Committee's conclusions regarding the health effects of CS spray were based on consideration of the toxicity data on CS and MIBK. As noted above there was very little information on the formulated product. The Committee's advice applies to all individuals exposed to CS spray during its use as a chemical incapacitant.

50. The Committee considered that the *available* data did not, in general, raise concerns regarding the health effects of CS spray itself. Local irritant effects are short term and there exists the possibility of skin sensitisation occurring in some individuals. It must be noted that no comprehensive investigation of the effects of CS spray in humans was available, nor has there been any systematic follow-up of individuals who have been sprayed with CS spray. The Committee has concerns regarding exposure to CS spray in susceptible groups. These are:

- Individuals with bronchial asthma or chronic obstructive airways disease whose condition could be aggravated by the irritant effects of CS spray on the respiratory tract.

- Individuals suffering from hypertension or other cardiovascular disease because of the transient effects of CS spray in increasing blood pressure.

- It was not possible, on the basis of the available data, to comment on whether individuals being treated with neuroleptic drugs are more likely to be sensitive to the effects of CS spray.

51. The Committee noted that adherence to the operational guidelines for the use of CS spray was of particular importance since at the time of exposure it would be exceedingly unlikely that the medical status of those exposed would be known. These concerns, and the uncertainties noted earlier, lead to the conclusion that particular care needs to be taken to follow the recommended aftercare guidelines for *all* persons exposed to CS.

52. The Committee considered that further information needs to be obtained on the effects of CS spray in humans. In this regard it was noted that systematic studies in volunteers to investigate the toxicity of CS spray may present insurmountable difficulties. The Committee thus *recommended* that follow-up studies be carried out on individuals treated for the immediate effects of CS spray in order to obtain data on whether delayed effects occur. Information should also be collected in these studies relating to the previous medical history of the individuals involved, particularly with regard to respiratory or cardiovascular disease, or treatment with neuroleptic drugs.

September 1999

COT Statement: COT/1999/06
COM Statement: COM/98/S2
COC Statement: COC/98/S4

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