Cot mattress biodeterioration and SIDS

SIR, - In 1988, various fungi were identified in industrial plasticised polyvinyl chloride (PVC) despite the presence of the preservative 10, 10'-oxybisphenoxyarsine (OBPA). Warnings were given that the PVC might also become infected by arsenic-tolerant organisms which might convert OBPA to toxic arsine gas. Mr P. R. Mitchell, a client of our company, inquired whether arsine generation through biodeterioration of such coverings might be a cause of sudden infant death syndrome (SIDS).

50 mattresses used in forty-five SIDS incidents were examined, including 1 cotton covered, 26 PVC covered, 15 PVC covered with exposed foam at one or both ends, and 8 exposed foam; in five incidents 2 mattresses had been used. All mattresses contained Scopulariopsis brevicaulis, but only in the area beneath the infant affected by warmth and perspiration. Incubated samples of the infected materials all generated toxic trihydride gases. PVC coverings usually generate stibine (SbH3) from a fire retardant additive, antimony trioxide, but also phosphine (PH_3) from the phosphate plasticisers that are used when Fire resistance is required. Although OBPA is not generally used in cot mattress PVC, tests indicated arsine (AsH3) generation when it was used; and small amounts of arsine were sometimes identified when it was not, presumably from arsenical impurities in antimony trioxide. Mixtures of gases were often detected. Phosphine generation from PVC was sometimes associated with the development of a pink stain, usually in the shape of the sleeping infant, apparently caused by liberation of phenol compounds from decomposition of phenyl phosphate plasticisers. Only phosphine was generated from infected cotton and foam samples, apparently through biodeterioration of phosphate fire-retardant treatments. Foam samples and the 1 cotton sample were also infected by various other fungi, especially in the area affected by dribble; many of these fungi produce asthmatic reactions.

The generation of highly toxic trihydride gases from cot mattresses is a serious threat to health. The gases are heavier than air, and infants most at risk are those who remain for long periods in their cots, sleep prone in carry-cots, or are heavily wrapped such that they are in long and close breathing contact with accumulations of gas. Heavy wrapping also induces hyperthermia which prompts an increase in gas generation. Some infants probably survive because the first symptom of poisoning is headache which results in irritability, dislodgment of bedding, and improved ventilation; infants with low weight cannot dislodge bedding. SIDS occurs mainly in infants up to age 5 months who sleep prone with heavy wrapping and have indications of hyperthermia. SIDS is only reported in western-style communities where foam and PVC covered cot mattresses are used, and has only been recognized since about 1969, following introduction of these materials during the previous 10-15 years.

It has been reported that SIDS is less likely to occur in first born children, perhaps because mattresses are new and do not become infected while the infant is young and most at risk. 5 first children were involved in the 45 incidents investigated. 2 died on previously used mattresses; 1 of these 2 slept on a mattress immediately after use by an older child. 1 infant died on a new foam mattress that was generating phosphine and 2 died on new PVC mattresses which were affected by exceptionally active fungus and were generating phosphine; two other new mattresses were implicated, both of which were similarly affected.

Infection by S brevicaulis is not readily visible in PVC. Severe deterioration, usually associated with phosphate plasticisers, results in brittleness and splitting. In the home the fungus is usually found in protein containing substances such as cheese and meat, and in damp wool and leather; however, its extracellular enzymes can convert a wide range of compounds containing the elements nitrogen, phosphorus, arsenic, and antimony into the trihydrides ammonia, phosphine, arsine, and stibine. The preferential development of this fungus in cot mattresses should be attributed to the presence of nitrogen compounds in the perspiration. The generation of arsine in this way has been recognized for about 100 years since Gosio[1] discovered that death in children and illnesses in adults were sometimes caused by arsine generated by the action of S brevicaulis on arsenical wallpaper pigments, although it is now known that arsine could be similarly generated from the horse hoof size that was commonly used at that time and which contained white arsenic to discourage rodent damage.[2]

Phosphine, arsine, and stibine are exceedingly toxic with threshold limit values of 0.3, 0.5 and 0.1 ppm, respectively, compared with 100 ppm for carbon monoxide. Relatively high ambient levels prevent the detection of phosphorus, arsenic and antimony residues at necropsy. However, some pathologists commented that they usually associate SIDS with abnormal lung colour; this could be associated with local erythrocyte haemolysis due to exposure to these trihydride gases.

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1. Gosio B. Azione di a'cune muffe sui oomposti fissi d'arsenico. Riv d'Igiene e San 1892, 3: 201-30, 261-73.
2. Thom C, Raper KB. The arsenic fungi of Gosio. Science 1932: 76: 548-50,

* A Government inquiry, prompted by these findings. was announced on March 9. The inquiry will be chaired by Prof. Paul Turner.

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