Recommendations of the Scientific Advisory Panel

PENTANE

CAS Number 109-66-0

June 13, 1994

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 120 ppm for pentane, and the American Conference of Governmental Industrial Hygienist (ACGIH) has a threshold limit value (TLV) of 600 ppm for pentane. Occupational Safety and Health Administration (OSHA) also has a permissible exposure limit (PEL) of 600 ppm for pentane. The TLV documentation discusses many acute studies that have been conducted in humans and animals that provides the basis for the TLV being protective against narcosis and irritant effects. The TLV documentation also discusses the basis of the NIOSH REL and finds that basis to be inappropriate.

A Chemical Abstract Service (CAS) on-line and a National Library of Medicine (NLM) literature search failed to locate any recent, long term animal toxicity studies upon which the initial threshold screening level (ITSL) could be based. A few available repeated dose inhalation studies conducted with pentane had only one dose level, contained relatively few animals, and only examined one endpoint - neurotoxic effects. Thus, a quality no observed adverse effect level (NOAEL) or lowest observed adverse effect level (LOAEL) was not able to be identified from those studies.

The NIOSH REL is based on a study which identified neurotoxic effects that occurred from occupational exposure to a solvent mixture of C_5 to C_8, Gaultier et al (1973). NIOSH assumed that all the C_5 to C_8 alkanes would have caused the same adverse effects, ie. neurotoxicity. Thus, NIOSH established a REL that would be protective of that effect, and applied it to C_5, C_6, C_7 and C_8 alkanes. Unfortunately the neurotoxicity observed in NIOSH's key study can only be attributed to one of the alkanes in the solvent mixture, hexane. Frontali et al (1981), and Takeuchi et al (1981) conducted studies which provides evidence that pentane is not neurotoxic when compared to hexane. Frontali et al (1981) exposed groups of six to nine male Sprague-Dawley rats to one of six analytical grade (99% pure) solvents, including pentane, hexane, and heptane. Rats exposed to 3000 ppm pentane for 9 hr/d, 5 d/wk for 30 weeks did not have giant axonal degeneration (neurotoxicity), as did the rats exposed to hexane. Takeuchi et al (1981) exposed groups of seven male Wistar rats to either no vapors, 3080 ppm pentane, 3040 ppm hexane or 2960 ppm heptane for 12 hr/d, 7 d/wk for 16 weeks. Nerve conduction velocities of the tail nerve, used here as an example of peripheral nerves, were measured on weeks 0, 4, 8, 12 and 16 of the study. Rats exposed to pentane had an absence of neuropathy (electrophysical and morphologic abnormalities). Rats exposed to hexane were observed to have developed those abnormalities, evident as decreased motor nerve conduction velocity, increased distal latency, and decreased mixed nerve conduction velocity. Thus, it can be concluded that hexane is a potent neurotoxin, while pentane and heptane are not observed to be neurotoxic.

Although Rule 232(c) does specify that the lower of the TLV and REL is to be used in calculating the ITSL, using the lower NIOSH REL which is based on hexane neurotoxicity in calculation of the ITSL for pentane is considered inappropriate. Due to a lack of available quality long term toxicity data upon which an ITSL can be calculated, the ITSL will be based on one percent of the ACGIH's TLV for

pentane, which was adopted by ACGIH in 1976, had the documentation updated in 1992, and is listed in their 1993-94 booklet. The ITSL derived from this method is 17,700 ug/m^3 with an 8 hour averaging time.

References:

ACGIH. 1992. Documentation of the threshold limit values and biological exposure indices, 6th Ed.

Frontali et al. 1981. Experimental neurotoxicity and urinary metabolites of the C5-C7 aliphatic hydrocarbons used as glue solvents in shoe manufacture. Clin Toxicol 18:1357-1367.

Gaultier et al. 1973. Polyneuritis and aliphatic hydrocarbons. J Eur Toxicol 6:294-296.

NIOSH. 1977. Criteria for a recommended standard - occupational exposure to alkanes C5 - C8. DHEW NIOSH Publication # 77-151.

Takeuchi et al. 1981. A comparative study on the toxicity of n-pentane, n-hexane, and n-heptane to the peripheral nerve of the rat. Clin Toxicol 18:1395-1402.