

MEMORANDUM

TO: Aaron Yeow, Science Advisory Board

FROM: David Bussard, National Center for Environmental Assessment – Washington Division

RE: Studies omitted from the draft carcinogenicity assessment of ethylene oxide

DATE: 22 October 2014

We wish to bring to your attention, and to the attention of the Chemical Assessment Advisory Committee Augmented for the Ethylene Oxide Review, information regarding two epidemiology studies of workers exposed to ethylene oxide (EtO) that were inadvertently omitted from the draft carcinogenicity assessment for this chemical.

One study, Morgan et al. (1981), was cited in the draft but not fully reviewed. The second study, Ambroise et al. (2005), was omitted. Both studies are relatively small, with small numbers of observed and expected total cancer deaths, making them less informative regarding the risks for specific cancer types from EtO exposure than the larger epidemiology studies relied on in the assessment.

The studies are available in EPA's HERO database, and summary details for each study are provided in the attached Table. EPA has reviewed these two studies and determined that their inclusion would not alter the cancer hazard characterization or inhalation unit risk calculations of the draft assessment. However, the studies will be incorporated in the final assessment.

Table. Omitted epidemiological studies of ethylene oxide and human cancer

Population/ Industry	Number of subjects	Extent of exposure to ethylene oxide	Health outcomes	Other chemicals to which subjects were potentially exposed	Limitations
Production workers, Texas Morgan et al. (1981)	767 men	Industrial hygiene survey in 1977 measured levels generally < 10 ppm.	11 cancer deaths vs. 15.2 expected (ICD NS) 0 leukemia deaths vs. 0.70 expected 2 Hodgkin lymphoma vs. 0.35 expected (no other lymphohematopoietic cancer deaths observed; total expected not reported) 3 pancreatic cancer deaths vs. 0.80 expected	ethylene, ethylene chlorohydrin, ethylene dichloride	Insufficient follow-up; few expected deaths in specific cancer sites ¹ No personal exposure information Exposures were likely to be low because the production process was a closed system and reaction systems were outside Workers with < 5 years of employment were excluded
Municipal pest- control workers, France Ambroise et al. (2005)	181 men; 140 were exposed to ethylene oxide, among other chemicals	not reported	21 cancer deaths vs. 9.36 expected. 1 leukemia death vs. 0.23 expected (ICD-9 204-208) (no other lymphohematopoietic cancer deaths observed; total expected not reported)	lists for the 1970s indicated that >60 chemicals were used in that time period, including carbamates, chlorinated hydrocarbons, and organophosphates; formaldehyde, metallic salts, anticoagulants, mercury dichloride	Small study with insufficient follow-up; few expected deaths in specific cancer sites No specific information on ethylene oxide exposure Mixed exposure to many other chemicals Reported deaths were for cohort as a whole; unclear which deaths were in ethylene oxide-exposed workers.

¹ Shore et al. (1993) report unpublished observations from an extended follow-up of this study presented by one of the co-authors at a conference. Three lymphohematopoietic cancer deaths were observed and 3.0 were expected – all 3 lymphohematopoietic cancer deaths were Hodgkin lymphoma.

- [Ambroise, D; Moulin, JJ; Squinazi, F; Protois, JC; Fontana, JM; Wild, P.](#) (2005). Cancer mortality among municipal pest-control workers. *Int Arch Occup Environ Health* 78: 387-393.
<http://dx.doi.org/10.1007/s00420-004-0599-x>
- [Morgan, RW; Claxton, KW; Divine, BJ; Kaplan, SD; Harris, VB.](#) (1981). Mortality among ethylene oxide workers. *J Occup Environ Med* 23: 767-770. <http://dx.doi.org/10.1097/00043764-198111000-00011>
- [Shore, RE; Gardner, MJ; Pannett, B.](#) (1993). Ethylene oxide: an assessment of the epidemiological evidence on carcinogenicity. *Occup Environ Med* 50: 971-997.