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**Air Quality Committee Meeting
Environmental Management Commission
Acceptable Ambient Levels for Hydrogen Sulfide
February 12, 2003
Dr. Leah Devlin**

Chairman Deerhake, members of the Commission, thank you for the opportunity to speak to you today. We recognize that you will consider many factors in your decision making process. My role, in fulfilling the responsibilities of the State Health Director, is to focus solely on the issues related to protecting public health.

In addition to this current discussion, the Division of Public Health and the Division of Air Quality have a long history of collaboration on other initiatives addressing environmental health impacts including:

- North Carolina Academy of Sciences Air Toxics Panel report that established the first Acceptable Ambient Air Levels in 1986
- Air Toxic Working Group that studied the state's Air Toxics Program in 1996
- Paw Creek study of volatile organic contaminants (1994 - 2001)
- Caldwell Systems hazardous waste incinerator (mid 1980's)
- Trinity Foam polyurethane foam manufacturer (1994 - 1998).

- Mercury emissions and impacts of fish tissue contamination (2001 - 2002)
- Ozone health impacts (2001 - 2002)
- Clean Smokestacks Legislation (2002)
- Assessing and Controlling Odors from Animal Operations (1999 - to current)
- Associated Asphalt Terminal hydrogen sulfide emissions - Rowan County (2002)
- Carolina Solite Corporation (1998 -2001)

Hydrogen sulfide can cause both acute and chronic health effects depending on the concentration and the duration of exposure. Hydrogen sulfide is known to be an eye and respiratory system, and mucous membrane irritant even at relatively low levels. Hydrogen sulfide has a "rotten egg " smell and it can be smelled at very low concentrations (1 to 10 ppb).

The current North Carolina one-hour AAL for hydrogen sulfide is 1500 ppb (1-hour average) and there currently is no 24-hour AAL. The current hydrogen sulfide AAL of 1500 ppb poses a serious health concern for people with asthma and should be lowered. A 24-hour AAL for hydrogen sulfide is also needed to reduce the risk of eye-related adverse health impacts in the general public

We in public health support the proposed recommendations of the Scientific Advisory Board (SAB) of 40 ppb (1 hr average) based on bronchial obstruction in asthmatics. We support both SAB proposal for a 24 hour average AAL of 23 ppb based on eye irritation in humans and also 83 ppb based on nasal lesions in rats. Clearly the 23 ppb level is more health protective. It is also based on human studies as compared to the 83 ppb level which was derived from a study done on rats.

Scientific Review

Our support for the SAB proposed recommendations is based on a review of the scientific findings of the SAB as well as the studies published subsequently to their reports. To briefly review, in the Jappinen study 10 asthmatics were exposed to hydrogen sulfide at 2000 ppb for 30 minutes. Of the 10 persons exposed, none had clinical symptoms of asthma, none had significant changes in their pulmonary function tests. However 2 of the 10 did have significant changes of greater than 30% in two parameters (airway resistance and airway conductance) suggesting significant bronchial obstruction which could increase the risk of developing asthma symptoms. The study does use a specific and reproducible hydrogen sulfide concentration for a defined period of time so that the exact dose to the individual is known. It is important to note that the study was conservative excluding severe asthmatics from participation. Therefore it cannot be determined from this study whether uncontrolled or more severe asthmatics might have an asthma exacerbation at exposure levels of 2000 ppb.

(At the 2001 American Thoracic Society International Conference) Secondly, the U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry presented an abstract summarizing a community study of adults and children in two cities exposed to hydrogen sulfide levels greater than or equal to 30 ppb and compared them to adults and children in cities with hydrogen sulfide levels less than 30 ppb (30 minute average exposure time). This study demonstrated a positive association between asthma-related hospital visits for adults and children (total 455 asthma hospital visits) and a positive association for child respiratory disease-related hospital visits (total of 5009 respiratory (including asthma) hospital visits) for those exposed to levels greater than or equal to 30 ppb compared to those exposed to levels less than 30 ppb. This study also shows that exposure to hydrogen sulfide levels above 30 ppb is associated with increased risk of exacerbation of asthma.

In addition to the ATSDR study, a community based symptom survey study in Hawaii of 97 adults living near geothermal wells, where 1 hour concentrations of hydrogen sulfide ranged from 1-47 ppb, revealed a 41% shortness of breath and 26% wheezing

response rate. The control group (persons living in areas with no known sources of hydrogen sulfide) reported a rate of 4% shortness of breath and 4% for wheezing.

Another community symptom survey study of adults exposed to hydrogen sulfide emissions from a pulp and paper mill revealed that eye symptoms, nasal symptoms, shortness of breath, and wheezing were higher on days when the hydrogen sulfide concentrations were greater than 14 ppb (24-hour average) when compared to symptoms when hydrogen sulfide concentration were less than 14 ppb.

ATSDR & EPA

These proposed recommendations of the SAB are also in line with other federal agency levels.

The U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry recommended level for 15 to 365 days of exposure (24 hours a day, 7 days a week) is 30 ppb based on respiratory effects in mice (ATSDR 1999, Agency for Toxic Substances and Disease Registry Toxicological Profile for Hydrogen Sulfide

The U.S. Environmental Protection Agency has proposed a reference concentration for chronic exposure of 1.4 ppb based on nasal lesions in rats (USEPA February 2002, DRAFT Toxicological Review of Hydrogen Sulfide). The current EPA reference concentration for hydrogen sulfide is 0.7 ppb (based on nasal mucosa inflammation in mice) following chronic exposure a 24 hour average over a lifetime.

Population and Area Impacted to Hydrogen Sulfide Levels Above the Proposed AALs

In October 2002, the North Carolina Division of Public Health requested air modeling data from the North Carolina Division of Air Quality to determine the impact radius on the extent and annual number of exceedances of these recommended levels around a

phosphate mining and fertilizer plant, a pulp and paper mill and an asphalt distribution terminal. In January 2003, it became clear that the majority of the hydrogen sulfide emissions released from the pulp and paper mills, the phosphate mining and fertilizer plant originates from the on site wastewater treatment plant and many of these emissions were not included in the October modeling. Therefore, a request was made to determine the impact radius for the pulp and paper mill again by including operational emissions and emissions from the on-site wastewater treatment plant.

Exceedances of the recommended 1-hour average level (or impact radius) of 40 ppb are estimated to occur between 0.25 to 25 miles beyond the property lines of these three facilities with 30 to 46 annual average exceedances per person exposed. For these three facilities alone, an estimated 81,769 individuals would be exposed to hydrogen sulfide levels exceeding the SAB recommended 1-hour average level of 40 ppb. Of this population, based on studies done in NC indicating asthma rates of approximately 10%, it is estimated that there are 8,259 asthmatics who would be exposed to hydrogen sulfide levels exceeding the SAB recommended 1-hour average level of 40 ppb at these 3 facilities. As a result these asthmatics are at increased risk for bronchial obstruction which may trigger symptoms of asthma.

Exceedances of the recommended 24-hour average level (or impact radius) of 23 ppb are estimated to occur between 0.031 to 18.6 miles beyond the property lines of these three facilities with 10 to 22 annual average exceedances per person exposed. For these three facilities alone, an estimated 50,142 individuals may be exposed to hydrogen sulfide levels exceeding the SAB recommended 24-hour average level to protect the general public from eye irritation at 23 ppb.

It should be noted that because of a lack of data on low concentration exposures, the dose-response curve between 40 ppb (the SAB proposed recommendation) and 1500 ppb (the current AAL) is not known. It should also be noted that there are other facilities in NC emitting hydrogen sulfide that are not required to meet any AALs and for which no data exists.

Conclusions

In summary, based on a review of the science behind the SAB proposed recommendations, the ATSDR study, other studies in the literature, comparable levels of EPA and ATSDR, and the current risks to asthmatics and the general public as evidenced by the latest air modeling and population exposure estimates; we support the proposed SAB recommendation for a one-hour AAL of 40 ppb and a 24-hour AAL of 23 ppb. The 23 ppb AAL is clearly more health protective and is based on human data. We also support the 83 ppb level as a significant improvement.

We further recommend that an inventory of all hydrogen sulfide emissions from all other major hydrogen sulfide sources in NC including animal operations, pulp and paper wastewater treatment plants, and municipal wastewater treatment plants be completed in order to protect the health of the public living where exposure to hydrogen sulfide levels emitted from these sources may also be occurring.