Recommendation on the Use of the Adjustment Factor for Peak Particulate Emissions and Dispersion in the Manganese Particulate Soil Inhalation Criteria (PSIC)
-A report to the Toxics Steering Group, Subcommittee for the Application of the Manganese Particulate Soil Inhalation Criteria (PSIC) in the Detroit Area

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Background

The adjustment factor for peak particulate emissions and dispersion is discussed in MDEQ-RRD (2007). An evaluation of the appropriateness of this adjustment factor in the manganese PSIC derivation is aided by a brief overview of the origin and basis for including this factor in the generic PSIC algorithm.

When the DEQ stakeholder workgroup originally developed the particulate soil inhalation criteria (PSIC) methodology, to be applied to a wide variety of substances, it was realized that there was an inconsistency regarding the averaging time for air impacts for some substances. While the vehicular erosion, wind erosion, and dispersion characteristics of the methodology were designed to address long-term (annual) emissions and impacts, there were some health benchmark values for noncarcinogens (AQD ITSLs) which had short-term averaging times (1 hr, 8 hr, or 24 hr) rather than annual averaging times. The AQD utilizes averaging times in association with the ITSL values, in evaluating the acceptability of emission impacts, establishing permitted emission limits, and interpreting air monitoring data. An inconsistency in the averaging times was problematic, because the intention of the workgroup was to establish a methodology for deriving PSIC criteria which would be health protective, with the ITSLs (and their associated averaging times) serving as the basis for that level of protection for noncarcinogenic effects. A focus on only long-term (annual average) emissions and impacts raised the possibility that short-term peak impacts could exceed the ITSL concentration, even if the calculated annual average impact did not exceed the ITSL concentration. The workgroup considered various optional approaches to address this concern for short-term excursions above the annual average concentration. Most compelling were the available empirical data, which indicated that monitored ambient air peak (90th percentile) particulate (PM-10) levels measured over 24 hour periods were roughly 2-fold greater than annual average PM-10 levels. Limited data also indicated that 1 hr and 8 hr peak levels were not substantially higher than 24 hr peak levels. Therefore, the workgroup incorporated into the generic methodology a 2-fold adjustment factor. That adjustment to the particulate emission factor effectively reduced the PSIC values by one-half (50%). This adjustment was intended to be applied to all PSIC criteria for noncarcinogens with ITSLs with 1 hr, 8 hr, or 24 hr averaging times (MDEQ, 1997; MDEQ-RRD 2007). The purpose of the adjustment factor was to help ensure that annual average soil contaminant impacts to ambient air would not exceed ITSL concentrations which have short-term averaging times.

Discussion

The AQD manganese ITSL of 0.05 ug/m$^3$ has a 24 hr averaging time. The ITSL is based on the EPA Reference Concentration (RfC) of the same value. EPA assigns a
daily dose-rate to Reference Doses (mg/kg-day), but they do not assign an averaging
time to RfCs. Although the RfCs are intended to be protective for a lifetime of exposure,
EPA has not provided written guidance on assigning averaging times for various
substances’ RfCs. The Air Pollution Control Rules specify that ITSLs that are derived
from RfCs and RfDs are assigned a 24 hr averaging time (Rule 336.1232(2)(b)).
Therefore, air emission sources that are subject to the AQD New Source Review
permitting program cannot cause incremental ambient air impacts exceeding the
manganese ITSL of 0.05 ug/m$^3$ (24 hr average), for the emissions from a proposed
process. The AQD Toxics Unit has granted case-by-case exemptions from complying
with the manganese ITSL (Rule 336.1226(d)) in cases where the facility-wide
manganese emissions and impacts do not exceed 2 ug/m$^3$ (8 hr averaging time) or 0.05
ug/m$^3$ (annual averaging time). The value of 2 ug/m$^3$ was derived from the occupational
exposure limit (200 ug/m$^3$, 8 hr time-weighted average) divided by an uncertainty factor
of 100 (to account for intraspecies variability and differences in exposure duration). The
purpose of that criterion (2 ug/m$^3$, 8 hr averaging time) is to help ensure protection of the
general public from peak short-term exposures.

In practice, EPA has directly compared RfCs to modeled annual average ambient air
concentrations to evaluate their health significance, for manganese and other
substances (e.g., National-Scale Air Toxics Assessment (NATA):
http://www.epa.gov/ttn/atw/nata1999/). EPA’s assessments of short-term ambient air
impacts have generally utilized other health benchmarks intended for acute exposure
scenarios (e.g., ATSDR acute MRLs or NAC AEGLs). Similarly, MDEQ-AQD (2005)
directly compared annual average ambient air monitoring data for manganese to the
ITSL (and RfC) value of 0.05 ug/m$^3$. For substances with California RELs, ATSDR
MRLs or NAC AEGL-1 values, the 24 hr monitoring results were compared to those
short-term health protective benchmarks (MDEQ-AQD, 2005).

Consideration of the concern for environmental manganese exposures indicates that the
critical (most sensitive) neurological effects have been associated with long-term
exposure and chronic effects, rather than acute exposures (ATSDR, 2000; EPA, 1993).
In order to compare the quantitative differences between the acute and chronic dose-
response relationships, it would be desirable to compare health protective benchmark
values for the different exposure durations. Unfortunately, there is no ATSDR acute
MRL, California REL, or NAC AEGL for manganese. The U.S. DOE has established a
Temporary Emergency Exposure Limit (TEEL-0) of 0.4 mg/m$^3$ for Mn chloride, and 0.3
mg/m$^3$ for Mn dioxide; the TEEL-0 is the threshold concentration below which most
people will experience no appreciable risk of health effects in emergency response
scenarios. For occupational settings, the ACGIH has established a TLV-TWA of 200
ug/m$^3$ for Mn and inorganic Mn compounds; NIOSH has set the REL-TWA at 1000ug/m$^3$
and STEL (15 minute TWA) at 3000 ug/m$^3$ for manganese compounds; and, OSHA has
established a PEL-Ceiling Limit at 5000 ug/m$^3$ for manganese compounds. These may
be compared to the EPA RfC of 0.05 ug/m$^3$. As previously noted, the MDEQ-AQD has
utilized a criterion of 2 ug/m$^3$ (8 hr averaging time) for determining the approvability of
facility-wide manganese emissions and impacts, coupled with a criterion of 0.05 ug/m$^3$
(annual averaging time).

Conclusion and Recommendation

Based on a review of the available toxicity information and health protection
benchmarks, protection against the chronic neurological effects of exposure to
manganese in airborne soil particulate appears to provide adequate protection from potential acute effects of manganese (assuming that peak 24 hr levels may be twice as high as annual average levels). Therefore, it is recommended that the current 2-fold adjustment factor in the derivation of the manganese PSIC value should be eliminated, on the basis that it does not appear to be necessary to ensure health protection for short-term peak levels relative to annual average levels.

References

ATSDR. 2000. Toxicological Profile for Manganese (Update).


