

H. 532 Section 5 Study

Monthly Progress Report October 2007

Prepared for:

CLF Ventures

Compiled by:

**Cambridge Environmental Inc.
and
Geosyntec**



Cambridge Environmental Inc

58 Charles Street Cambridge, MA 02141
www.CambridgeEnvironmental.com

1

Geosyntec
consultants

289 Great Road, Suite 105, Acton, MA 01720
www.geosyntec.com

Background and Introduction

The Section 5 study of the Omya site in Florence/Pittsford, Vermont, is being conducted in two Phases. Phase I of the Section 5 Study was completed in January 2007, culminating in a detailed Phase I project report. Phase I focused on the assessment of existing data and studies, and led to the identification of new data to be collected in Phase II. The current stage of the Section 5 Study involves continued data collection and interpretation, leading to an holistic assessment of environmental and public health impacts.

Progress this month, and plans for future work, are as follows. (Readers wishing to review Progress Reports from prior months may access these at http://www.omyainvermont.net/lib_sect5.htm#Section5Notes).

Meetings

On October 12, 2007, one of us (Lawrence Copley) participated in a meeting at Omya to discuss progress on noise issues. Others attending the meeting were Mike Laurent and Rob Tikoft of Omya, Jason Ross of HMMH (Omya's noise consultant), and Pat and David Rosato (two residents concerned about noise from Omya's operations). Omya has continued conducting sound monitoring with their acoustical monitoring instrument. Jason Ross presented recently acquired acoustic data, followed by discussions of what tasks should be performed in the continuing effort to address noise concerns.

On October 29, 2007, some of us (Mike Ames, Steve Roy, and Steve Zemba) met with members of the Oversight Team (O.T.) and other interested parties. Notes of the meeting will be posted following O.T. review and approval.

On October 30, 2007, some of us (David Adilman, Laura Green, Peter Zeeb, and Steve Zemba) met with the Agency of Natural Resources (ANR) Secretary George Crombie, several members of his staff, and several members of the Department of Environmental Conservation (DEC). We reported on our findings and interpretations to date, focusing on aminoethylethanolamine (AEEA), arsenic (As), and, to a lesser extent, perchlorate (ClO_4^-), engaged in vigorous and productive technical discussions, and offered to continue to assist ANR/DEC as requested and appropriate.

Overview of Hydrogeology and Surface Water Study

This month we continued to evaluate our Phase II data (as well as data collected by Omya's consultants as part of their twice-yearly monitoring activities), and to write-up and/or depict these data for our draft final Report. Our evaluation has included review of bedrock geology, horizontal and vertical groundwater gradients, and contaminant

distribution in both surface water and groundwater. As part of ongoing data analysis, we identified several additional data needs, and worked with the Vermont Agency of Natural Resources (ANR), Omya, and Omya's consultant, Heindel and Noyes, so that Heindel and Noyes could collect additional samples (in mid-October) as part of Omya's periodic monitoring activities. These additional analyses and samples included:

- Analyzing groundwater for the specific "species" of arsenic; that is, distinguishing the trivalent species, arsenite, from the pentavalent form, arsenate (these data will improve our understanding of the possible sources, transport, and fate of arsenic in groundwater at the Site);
- Analyzing samples of supernatant (that is, water that rose to the top as tailings settled, plus any rainwater/run-off that may have mixed with this water) from the Dolomite as well as Kane and Drake Tailings Management Areas (TMA's) for total and dissolved metals, and for flotation agent (these data will help us better understand the source(s) of arsenic and AEEA that are observed in groundwater and surface water at the Site);
- Collecting samples from additional surface water locations for flotation agent analysis (focusing in particular on AEEA, the smallest component of flotation agent by volume but the most important with regard to potential health risk, given its newly uncovered teratogenicity) (these data will help clarify the fate and exposure potential of AEEA);
- Measuring low-flow geochemical parameters from selected residential wells (these data may help explain arsenic distribution and allow better inferences to be made as to the possible source(s) of arsenic to groundwater);
- Analyzing groundwater from Wells F, N, and E, and surface water at Chruscziel Spring for major cations and anions (these data may allow us to infer possible migration pathways for Site groundwater to the Chruscziel Spring); and
- Collecting filtered and unfiltered samples from MSGP Discharge SN-002 (formerly identified as NPDES SN-001 and OC-1) for analysis of iron, manganese and arsenic (these data will be used to verify prior results from this location).

Hydrogeology

A new groundwater elevation survey was conducted at all existing and new wells. The new groundwater elevation data generally confirm the hydraulic gradients identified in the Site Characterization Report (although, as noted below, a small portion of site-affected water also appears to reach the Chruscziel Spring). The data continue to indicate that hydraulic gradients generally converge from the west and east toward the center of

the Site from the Kane and Drake as well as Dolomite Quarries. The groundwater elevation in Well P is approximately 20 feet higher than Well B to the southeast in the Kane and Drake. This result provides strong evidence that that groundwater beneath the Kane and Drake does not flow westward toward Fox Rock Spring. Groundwater elevations from Wells G and H on the eastern side of the Dolomite Quarry are more than 20 feet higher than Wells J and 2 in the center of the Site, providing strong evidence that groundwater from the Dolomite Quarry does not migrate to the east, but instead to the northwest. Data from new wells downgradient of the Verpol plant show that a strong potential for converging flow toward the center of the site exists even downgradient of the Verpol Plant.

Vertical gradients were calculated for Wells B, 2, K, L, M, and N. At Wells B, K, L, and M, significant potential for vertical flow is not apparent. However, Well 2 is located in a zone with vertically upward flow from deep and vertically downward flow from shallow zones, with most flow exiting in middle depths in the borehole. The groundwater elevation data indicate gradients converging to the Well 2 area, and as such, the finding of significant vertical flow in this area of the Site is not surprising. Data from Well N indicate upward flow from deeper rock to the shallower zones.

Contaminant Distribution and Interpretation

Considerable amounts of analytical chemical data¹ indicate the following:

Overall, Omya's operations (and the site as a whole, including the Hogback Quarry, and presumably including the legacy of pre-Omya operations) present three chemicals of concern. These are, in order of potential significance, **aminoethylethanolamine (AEEA)**, **arsenic (As)**, and **perchlorate (ClO₄⁻)**. Fortunately, none of these chemicals has affected any source of drinking water — either at all, or to any significant or otherwise meaningful degree. In particular:

AEEA has never been detected in drinking water;

Arsenic has been detected in many samples of drinking water, but only at naturally occurring background concentrations (which are within drinking water standards, and believed to be safe); and

¹ These data derive from 19 on-site groundwater monitoring wells, 13 off-site drinking water wells (private and public), and 12 surface water locations both, onsite and offsite. In all, data on nearly 200 different chemical contaminants were sought — including those characteristic of Omya's processes, and the much larger set of "standard" potentially hazardous chemical contaminants, such as metals, pesticides, and scores of other organic chemicals. Although no sampling and analysis program can ever be considered complete or definitive, the data generated to date are comprehensive in nature and quite informative.

ClO_4^- has either not been detected in drinking water, or (in three private wells and in the Pittsford-Florence Water District [PFWD] supply well) has been detected at vanishingly small (0.2 parts per billion or less) concentrations (which concentrations, again, are not believed to harm health).

Further discussion of these three chemicals follows.

AEEA

As the most water-soluble, environmentally mobile, and potentially toxic component of flotation agent, AEEA is the Omya-related chemical of greatest potential concern.² Since flotation agent is used daily, and flotation agent-containing water and tailings are deposited into one of two settling cells onsite daily, AEEA is expected to be present, at decreasing concentrations, in the settling cells, the first TMA (where tailings are still relatively wet), the second TMA (where tailings are on the order of 85% solids, 15% water), and any surface waters that received discharges, planned or otherwise, from these cells or TMA's. Such surface water includes the Pittsford Italian Quarry (PIQ) onsite. The PIQ is used as a collection point for Site stormwater and the principal source of water to the Verpol Plant. To the extent that AEEA-containing surface water is in contact with fractured bedrock or other transmissive features, AEEA has the potential to contaminate groundwater.

Observed AEEA contamination of groundwater, however, is quite limited. In particular, about 100 parts per billion (ppb) of AEEA is found in one monitoring well that is in intimate contact with tailings, and lower (10's to single-digit ppb) concentrations are found in only three other wells, all of which are located immediately downgradient of either the settling cells or the TMA's. No AEEA (with a lower limit of detection of about 2 ppb) has been detected in any of the other downgradient wells on the property, and none has been detected in any well, spring, or surface water offsite, with one exception (below). Whether this limited distribution of AEEA in groundwater is due to natural biodegradation, other means of natural attenuation, and/or simply a limited amount of AEEA entering groundwater onsite, from tailings-associated water or any other source, has not been determined.

² Since (i) AEEA is present in flotation agent at concentrations of only 2% or less, (ii) is present in flotation agent only as an unwanted residue from the chemical reaction used to make the primary active ingredient, TOHI, and (iii) was not known, either by us, Omya, the State of Vermont, or any other "stakeholders" to be a potent teratogen until two months ago, the fact that AEEA has become the most, and perhaps only, important chemical of concern in this investigation was certainly not expected. We understand, from several discussions with Phil Goss and others at Omya, that Omya's two suppliers of flotation agent have since been tasked with developing an appropriate, low-or-no AEEA-containing flotation agent as soon as possible. We also note that the material safety data sheet (MSDS) from one of these suppliers is completely silent as to the teratogenicity of AEEA, while the MSDS from the other supplier gives only minimal and largely misleading information in this regard.

Water in one offsite non-potable spring northeast of the site, the Chrusciel Spring (so named because it is on property owned by Dan and Rosie Chrusciel), has been found to contain single-digit part per billion (ppb) levels of AEEA on three of four sampling occasions, and low levels of stearic acid (an essentially nontoxic natural fat used by Omya to coat its ground calcium carbonate) on two occasions. Since there is no known “background” concentration of AEEA, this is strong evidence of an offsite impact from Omya. By the same token, since (i) the concentrations of AEEA in this spring are all less than 10 ppb (the most stringent of two or three possible drinking water guidelines; see below); (ii) the spring is not potable water; and (iii) these concentrations of AEEA present no significant risk to the environment, we do not consider this offsite impact to be significant.³

Arsenic

Both tailings and natural soils/rock on the site likely contain low part per million concentrations of arsenic. Tailings likely contain As at levels that are somewhat (perhaps five-fold) concentrated relative to the unprocessed ore whence they derive, though these concentrations are too small to be considered hazardous. Nonetheless, the process of landfilling tailings with perhaps 0.5% organic content onsite, over the decades, has likely changed the geochemistry of the groundwater beneath the TMA’s by depleting it in oxygen (by limiting oxygenated rainwater percolation and through oxygen-depleting degradation of natural and introduced organic matter). Capping of the TMA’s could, moreover, increase the geochemical “footprint” of the Site.

This geochemically reduced water is more likely to solubilize naturally occurring iron (Fe), manganese (Mn) and arsenic (As) present in rock in oxidized states. Monitoring data show clearly elevated concentrations of iron (Fe) and manganese (Mn) in many onsite wells, co-located with areas of the Site where surface water infiltration is limited and disposal of materials containing organic matter has occurred.

The pattern of *arsenic* occurrence is less clear: in some areas within the “footprint” of elevated iron and manganese, arsenic is also elevated above background; in other areas it is not. The lack of a consistent spatial correlation between the geochemical indicators of iron and manganese and elevated arsenic may be related to variability in arsenic content

³ As noted on several occasions, hydraulic gradients in the bedrock in the northeastern corner of the Site appear to be toward the northwest, *away* from Chrusciel Spring. However, there are no groundwater elevation data near the Upper East Settling Basin (UESB) and/or the area between the UESB and Chrusciel Spring. Because this spring is wet even during the drier summer months, and because it occasionally contains low levels of Omya-related chemicals, it appears to us that a small amount of groundwater from the Verpol property likely does discharge to the Chrusciel Spring area.

of native rocks, the effects of other arsenic attenuation processes in groundwater, and/or geochemical disequilibrium. Further, the mechanism for arsenic release from tailings and/or native rock has not been directly demonstrated. A more conclusive result would require evaluation of the arsenic speciation data discussed above, as well as additional studies beyond the scope of the Section 5 study. Nevertheless, our provisional conclusion represents a reasonable operating hypothesis. Groundwater onsite contains on the order of 1 – 20 ppb As; no drinking water samples have contained As at concentrations greater than 2 ppb, below the drinking water standard of 10 ppb.

We have recommended (and the DEC has mandated) that Omya install and sample three new wells, just downgradient of the site (that is, just north-northwest of Whipple Hollow Road), to determine whether and to what extent Fe, Mn, and/or As may be there at elevated concentrations.

Perchlorate

As noted in previous Progress Reports, water pumped from the Hogback Quarry (a source of marble for site processes) is discharged through settling basins either to the south to a tributary to Smith Pond, or to the north to an unnamed tributary to Otter Creek. Although water in the Hogback Quarry has been found to contain ppb concentrations of perchlorate, presumably due to historic uses of perchlorate-containing explosives, detected concentrations of perchlorate in public and private water supply wells, Smith Pond, and the Otter Creek have ranged from none to negligible. Thus, though perchlorate has likely migrated from the Hogback Quarry, it has not done so to any toxicologically significant degree.⁴

We are currently evaluating results of the hydrogeologic and contaminant investigations to update our **Conceptual Exposure Model (CEM)** with regard to groundwater, surface water, and drinking water. As indicated above, this CEM will show no impacts from Omya's processes or tailings management practices to public or private drinking water supplies. It will, however, show impacts of approximately 200 ppb of AEEA onsite to the Pittsford Italian Quarry (PIQ). Currently, under a National Pollutant Discharge Elimination System (NPDES) permit, water from the PIQ may be pumped to the Lower East Settling Basin during periods of heavy rain. From the Lower East Settling Basin, water discharges to an unnamed tributary of Otter Creek. The occasional nature of these discharges, combined with both the substantial dilution occurring along the way and the

⁴ Pumped discharge from the Hogback Quarry migrates southeast in a tributary which meets the Otter Creek approximately 650 feet *north* of the PFW. The PFW is *south* of where this water discharges to Otter Creek and *the Otter Creek migrates northward*. Therefore, we are uncertain as to how perchlorate has made its way into the PFW supply well, or even whether it is due to blasting at the Hogback, other Omya-related activities, or some other source entirely. Regardless, the concentrations found have been so negligible that this uncertainty is of academic interest only.

lack of AEEA detected in the PFWD supply well or other drinking water supplies, indicate no significant risk from this permitted activity. Nonetheless, reducing or eliminating AEEA in flotation agent would, of course, reduce or eliminate any threat from AEEA.

Stormwater from elsewhere on the Site is collected in a detention basin on the western edge of the Site, near the truck washing facility. Normally this water is pumped to the PIQ. The NPDES permit for the site allows high water overflow from this basin to an unnamed tributary of Smith Pond. Our investigation of **Smith Pond** has found no chemical or biological evidence of adverse impact.

Hazardous Air Pollutants (HAPs)

Preliminary results of the HAPs study were presented to the O.T. at the October 29, 2007 meeting. The methods used to estimate air pollutant concentrations in air due to Omya's entire manufacturing facility are described in our September 2007 progress report. The HAPs study considers all pollutants detected in stack testing at Omya as well as additional pollutants that the U.S. Environmental Protection Agency (EPA) has determined to be associated with fuel oil combustion.⁵ Pollutants considered in our HAPs study are:

- A series of aldehydes (a class of partially oxygenated hydrocarbons)::
Acetaldehyde, Benzaldehyde, Butyraldehyde, Crotonaldehyde, Formaldehyde, Heptaldehyde, Hexaldehyde, Isovaleraldehyde, Nonanal, Octyl aldehyde, Propionaldehyde, and Valeraldehyde;
- Additional organic compounds:
Acetone, Acetophenone, Acrolein, Benzene, Bis(2-ethylhexyl)phthalate, Bromoform, 2-Butanone (MEK), Carbon disulfide, Chloroform, Chloromethane, Dichlorodifluoromethane, Di-n-butyl phthalate, Ethylbenzene, Fluoranthene, 2-Hexanone, Iodomethane, Methylene chloride, 4-Methyl-2-Pentanone, Naphthalene, Nitrophenol, Palmitic Acid, Phenol, Styrene, Tetrachloroethene, Toluene, 1,1,2-Trichloroethane, Trichlorofluoromethane, *m&p*-Xylene, and *o*-Xylene;
- Chemicals associated with fuel oil combustion (per EPA guidance/data):
 - Organic Compounds :
Acenaphthene, Acenaphthylene, Anthracene, Benz(a)anthracene, Benzo(b&k)fluoranthene, Benzo(g,h,i)perylene, Chrysene, Dibenz(a,h)anthracene, Fluorene, Indeno(1,2,3-cd)pyrene, Phenanthrene, Pyrene, and 1,1,1-Trichloroethane;

⁵ It should be noted that not all pollutants we consider are designated as Hazardous Air Pollutants within the federal Clean Air Act – the HAPs designation is used as a matter of simplicity/convenience. Also, some pollutants detected in stack testing are likely the result of quality assurance problems common in stack testing (such as residual presence due to their use in analytical laboratory procedures).

- Metals:
Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury, Nickel, Selenium, and Zinc.

Table 1 summarizes the emissions of four key Hazardous Air Pollutants.⁶ As expected, emissions from production processes at the Verpol Plant are larger than emissions from the East Plant. Verpol Plant emissions, not available in our Phase I evaluation, are based on stack testing of sources representative of the various processes Omya uses in its calcium carbonate production. The “Other Oil Combustion” category covers sources not directly involved in calcium carbonate production — primarily the cogeneration facility and boilers used to generate process steam.

Table 1 Estimated emissions of key Hazardous Air Pollutants

Pollutant	Estimated emissions in lb/yr due to:		
	East Plant Processes	Verpol Plant Processes	Other Oil Combustion
Formaldehyde	290	2300	250
Acetaldehyde	240	6100	2
Acrolein	100	430	0.2
Benzene	6	110	4

Determination of larger emissions from the Verpol facility processes represents an important refinement over our Phase I evaluation that translates into larger overall estimates of HAPs concentrations in ambient air. However, no modeled concentrations exceed Vermont’s Hazardous Ambient Air Standards. In general, the predicted concentrations due to Omya emissions are well within background concentrations — only for acrolein is our predicted incremental concentration due to Omya emissions (0.01 µg/m³) the same as the estimated background level in Florence air. The estimated resulting total concentration of this aldehyde is still acceptably small and not expected to harm health.

Ambient Dust

The final set of ambient total suspended particulate (TSP) samples, time resolved dust monitoring, and meteorological measurements were collected on October 27. The overall sampling period was extended from the originally scheduled period by about one week to compensate for three dust sampling dates (August 13, 16, and 19) that were missed due to malfunctions with the microbalance used at UVM to weigh the filters before and after

⁶ These four pollutants are selected because their emission levels trigger more detailed evaluation under Vermont’s Hazardous Air Contaminant rule.

dust collection. Post-sampling weighing of the filters is complete through those collected on October 15. The post-sampling weighing of the remaining TSP samples will be completed in early November. Because of the need for an extended time (one week) for the filters to equilibrate to the weighing conditions and their weights to stabilize, the time between the collection of the samples and the determination of the ambient TSP concentrations is longer than originally anticipated.

On October 12, sieved samples of bulk and surface material collected at Omya, Hogback Quarry, nearby public roadways, and each dust study sampling site were sent to RJLee Group Inc. for elemental analysis by inductively-coupled plasma atomic emission spectroscopy (ICP-AES), and crystalline silica analysis by X-ray diffraction (XRD). On October 15, 79 of the 24-hour TSP dust samples collected on filters, and 3 each of field, trip, and laboratory blank filters were also sent to RJLee for elemental analysis by ICP-AES. Some of the results of these analyses have been received and are being reviewed; the remaining results are expected to arrive in the first full week of November.

On October 30, a CD-ROM containing the raw analytical data (*i.e.*, individual filter weights before and after sampling, and measured sample air volumes) for the TSP samples collected through October 15, were sent from UVM for our QA/QC review. In particular, we will review the data and the calculations performed by UVM to assess the reliability of the reported ambient TSP concentrations.

Since dust related data are still being generated and verified, we will present our findings and interpretations in the November Progress report.

Toxicology / Health Risk Assessment

Drinking water

This month's efforts have focused on estimating acceptable concentrations for AEEA in drinking water. Preliminary calculations (presented below) suggest that drinking water containing 60 ppb or less of AEEA is a safe level for pregnant women (to protect their fetuses from the risk, so far known only to occur in rats, of AEEA-induced birth defects) and that water containing 10 ppb or less of AEEA is a safe level for young infants (presuming that AEEA also has adverse effects during the first several months of life)⁷. Accordingly, we asked the analytical laboratory, TestAmerica, to reduce its lower limit of reporting to 2 ppb, if possible. As indicated below, the laboratory has succeeded in this regard.

⁷ Low doses of AEEA might harm fetuses or infants; but, because of its relatively low toxicity in every respect *except* with regard to its teratogenicity, children or non-pregnant adults would not be expected to be harmed at even relatively high doses.

Our estimates of safe concentrations of AEEA in drinking water for humans presumed to be sensitive to AEEA teratogenicity (in particular, pregnant women [more precisely, their fetuses] and infants) have been made under the following assumptions:

- A safe daily dose is 2 micrograms (μg) per kilogram body weight (kg) per day (derived by dividing the LOAEL of 200 $\mu\text{g}/\text{kg}\text{-day}$ in Wistar rats exposed to AEEA *in utero* and perinatally⁸ by a combined safety factor of 100)
- Absorption across the gut is the same for rats and humans
- Water intake by a pregnant woman is 2.4 liters/d
- Water intake by a nursing woman is 3.0 l/d
- Equal concentrations of AEEA in maternal body water and breast milk

1. Consumption of AEEA in drinking water by a woman in the third trimester of pregnancy

- 1.1 If body weight is 70 kg, then the permissible intake of AEEA is 140 $\mu\text{g}/\text{d}$.
- 1.2 If water intake is 2.4 l/d, then the permissible concentration of AEEA is 140 $\mu\text{g}/\text{d}$ / 2.4 l/d = **60 $\mu\text{g}/\text{liter}$** . (We believe that all of these estimates of allowable concentrations in drinking water should be expressed to only one significant digit.)
- 1.3 If body weight is 75 kg, then the allowable concentration also rounds to **60 $\mu\text{g}/\text{l}$** .

⁸ In unpublished studies of prenatal developmental toxicity in Wistar rats (by The Experimental Toxicology and Ecology Laboratory at BASF-AG, Ludwigshafen, 2003 and in preparation), AEEA was found to cause aneurysms in the aorta or other major blood vessels, in fetuses and newborns, at these dose-response rates:

Dose to rat dams (mg AEEA/kg b.w.-day)	Response (# affected rat pups / # exposed <i>in utero</i> and/or through day 4 after birth)
1,000	No live births; 100% embryo-fetal lethality
250	Raw data not provided in summary report; apparently aneurysms appeared in about 50% of the offspring
50	62 / 270
5	2 / 288
1	5 / 319
0.2 (= 200 $\mu\text{g}/\text{kg}\text{-day}$ = LOAEL)	2 / 298
0	0 / 304

Malformations of this type are not known to occur spontaneously in laboratory rats, and are known to be induced by one other chemical, semicarbazide [which bears no other obvious relationship to AEEA].

2. Consumption of AEEA in drinking water by a woman breastfeeding a baby 0-6 months old

2.1 Average infant body weight at the 50thile during this time is about 6 kg (*Exposure Factors Handbook* Table 7-1); thus, the safe daily dose of AEEA for the infant is $2 \mu\text{g}/\text{kg}\cdot\text{d} \times 6 \text{ kg} = 12 \mu\text{g}/\text{d}$.

2.2 Average milk intake for an infant 0-6 months is approximately 0.74 l/d (*Exposure Factors Handbook* p. 14-8). The maximum concentration of AEEA in breast milk is therefore $12 \mu\text{g}/\text{d}/0.74 \text{ l}/\text{d} = 16 \mu\text{g}/\text{l}$.

2.3 What concentration of AEEA in drinking water will produce 16 $\mu\text{g}/\text{l}$ in the mother's extracellular water (ECW)? According to Silva *et al.* (2007), the 50thile of ECW for a 70-kg woman is roughly 18 l. On the assumptions that AEEA distributes exclusively to body water, that 100% of daily intake of AEEA is eliminated daily, and that the AEEA is unmetabolized, then an AEEA concentration in ECW of 16 $\mu\text{g}/\text{l}$ is produced by daily intake of $16 \mu\text{g}/\text{l} \times 18 \text{ l} = 288 \mu\text{g}$ AEEA.

2.4 A nursing mother will receive this total daily dose of AEEA if drinking water contains about **100 $\mu\text{g}/\text{l}$ AEEA**: $288 \mu\text{g}/\text{d}/3.0 \text{ l}/\text{d}$.

3. Concentration of AEEA in drinking water used to make formula for a baby 0-6 months old

3.1 The safe daily dose of AEEA for the infant was calculated above to be 12 $\mu\text{g}/\text{d}$.

3.2 On the assumption that nursing babies consume 0.74 l formula/d (same rate as for breast milk), the concentration of AEEA in water used to reconstitute powdered formula is $12 \mu\text{g}/\text{d}/0.74 \text{ l}/\text{d} = \mathbf{20 \mu\text{g}/\text{l}}$.

3.3 The 90thile of average body weight for infants 0-6 months is about 6.5 kg. The upper percentile of milk intake (assumed equal to formula intake) is about 1 l/d. These factors would require a slightly lower limit on AEEA in water, about **10 $\mu\text{g}/\text{l}$** .

These estimates are very tentative, since, among other things, they are based on limited data, with uncertain relevance to humans. Nonetheless, we think that they are the best that can be done with current quantitative and qualitative information. Apparently, no other toxicologists, neither at U.S. EPA, at any state regulatory agency, nor anywhere else have made (or at least published) any such estimates, apparently believing that AEEA, although produced and used in large quantities (it is one of about 3,000 "high production volume chemicals"), is not likely to contaminate drinking water (*per* personal communication with William Stott, Ph.D., D.A.B.T., Dow Chemical Company; Andrea Blaschka, TSCA 8(e) Coordinator, U.S. EPA; and others).

Hazardous Air Pollutants

Modeled long-term and short-term concentrations of HAPs in air in the local community were evaluated for their potential to harm health and (for long-term modeling only, as appropriate) to increase the risk of cancer. Comparisons were made to allowable ambient air concentrations and to cancer effect levels for each chemical. Such toxicity “benchmarks” were available for most but not all modeled HAPs.

Long-term (even lifelong) exposures to HAPs emitted by Omya are not expected to be harmful. No non-cancer injuries are expected, and none of the exposure levels exceed the benchmark allowable concentrations in air. The theoretical increase in cancer risk, under the assumption that a person would be simultaneously exposed to all HAPs at the highest modeled concentrations for a lifetime (which assumption is clearly “worst-case”), is on the order of one in one million, a risk level typically viewed as acceptable by regulatory authorities and others, including us. The largest contributors to this increased cancer risk are acetaldehyde, formaldehyde, and arsenic. Of these, only arsenic is generally recognized as a “known” human carcinogen. Arsenic was included in the HAPs assessment because it is assumed to be emitted by Omya’s oil combustion sources (since it is a trace contaminant of all fuel oil); stack testing for arsenic emissions has not been conducted at any of the sources at Omya, but has been conducted at many other oil combustion facilities.

Short-term exposures to HAPs are also quite likely to be safe. The modeled short-term concentration for acrolein exceeds a benchmark set by the California EPA, but not benchmarks used by other states. We believe that the California benchmark is unnecessarily strict and that the largest exposures to acrolein in Florence are not dangerous or irritating. None of the other HAPs modeled in the short-term scenario exceeded toxicity benchmarks.

Overall, the HAPs modeling results indicate that compounds of concern emitted from all of Omya’s facilities do not lead to excessive ambient concentrations in the surrounding area, and that no significant health risks are expected to result from exposure to Omya’s HAP emissions.

Noise

A rare opportunity for noise source identification occurred October 1-3, 2007. Over this two-day period, much of the Verpol Plant was shut down for planned maintenance. The shut-down and start-up occurred sequentially by department. This sequencing offered the possibility of identifying specific noise sources that contribute significantly at nearby residences. The acoustic instrument was set up at the David Rosato residence during this period, and monitored sound continuously during the night-time portions of the shut-down and start-up. Production records are also available, showing the times at which different machines were operating or stopped. Omya’s acoustical consultant (HMMH) is

continuing to review the acoustic and production data, seeking to identify significant noise sources within the plant.

We have previously recommended conducting ambient sound monitoring at one or more residential locations not affected by noise from Omya operations. We refer to these as “proxy” locations. The reason for ambient sound monitoring at such proxy locations is to quantify rural residential ambient sound profiles that are typical for this area of Vermont. A typical ambient sound profile in the absence of noise from Omya operations could provide a basis for establishing acceptability criteria for noise emitted by Omya and reaching residential properties.

One suitable proxy location is the Brod residence on Humphrey Road. Continuous ambient sound monitoring was conducted there over two nights: October 17-19, 2007. Preliminary analysis of these data indicates that the night-time ambient sound levels at Humphrey Road are substantially lower than what has been measured at the D. Rosato residence near Markowski Road. Further analysis will be needed to determine how much of this difference is due to Omya operations affecting the Markowski Road area, and how much is due to inherently different acoustical conditions in the Whipple Hollow Road corridor, independent of Omya’s operations.

In connection with plant noise source identification, we conducted a technical investigation using the acoustic data collected by Omya over the period from June 26 to August 2, 2007. These data included in-plant measurements of acoustic signatures of individual noise sources, and extended monitoring of sound at the D. Rosato residence on Markowski Road. Both sets of data included 1/3-octave frequency analysis as well as audio recordings. By comparing the numeric signatures and audio character of the sound reaching the residence with those for individual in-plant noise sources, it was possible to identify two sources with likelihood of being significant contributors of tonal sound. Further calculations using the in-plant noise measurements for these two sources confirmed that they are likely to be significant contributors of tonal sound reaching the Markowski Road area. This tentative conclusion should be investigated further. If confirmed, then it would probably be feasible to attenuate this tonal sound so that it is not noticeable at residences.

This investigation of the June-August data also confirmed that there are significant levels of low-frequency broad-band noise reaching the Markowski Road area, most likely from the Verpol Plant. The specific source(s) have not been identified. However, it may be possible to make this identification from the plant shut-down acoustic data acquired October 1-3, 2007. This low-frequency noise may be more difficult to attenuate than the tonal sound mentioned above.

Analytical method for detecting and quantifying AEEA and other flotation agent chemicals

At our request, the analytical laboratory TestAmerica has determined that it can, in fact, reduce its lower limit of detection for AEEA in water samples from 20 ppb to 2 ppb. This reduction allows us to be confident that samples reported as “not detected” genuinely contain either no or only *de minimis* concentrations of AEEA, and, by the same token, that samples containing, for example, 10 ppb of AEEA are no longer considered (by us, at least) as “not detected.”

Using two different chromatographic systems, TestAmerica has also verified that detections of AEEA in the PIQ and elsewhere that had been reported earlier do appear to be true detects. More generally, the use of the HPLC/MS/MS analytical method to detect and quantify AEEA continues to be a major improvement over the previous, less specific, AG-24 method.

Quality Assurance / Quality Control

All of the analytical data received to date from our Section 5 study have either been fully validated or undergone a QC review and inventory. We are currently drafting a report regarding this QA/QC work, and expect to have this report completed by mid-November.

Particulate matter data from the ambient air monitoring study being performed for us by Professor Holmen at the University of Vermont have just been received, and are currently undergoing validation.

Anticipated Work

In November and December, we will further analyze existing and newly received data, determine whether and how to collect additional data, meet with the O.T. and related parties, finalize (to the extent possible) our Conceptual Exposure Model, formulate suggestions for future work, and draft our final report.

With regard to health risk assessment, we shall continue to investigate to issues surrounding AEEA and other chemicals of concern, and provide assistance to members of the O.T., as well as the ANR, and/or the Department of Health, as requested.

With respect to the dust monitoring study, the final TSP concentration data, and elemental composition data, will be obtained and reviewed in early November. Our analysis of these data will be completed in November, allowing us to assess the extent to which operations at Omya’s facilities and truck traffic in the area contribute to ambient dust levels.

With regard to our noise analyses, we will continue reviewing acoustic data collected by Omya. From this review we will recommend a conceptual approach for establishing noise acceptability criteria appropriate for the particular situation of the Verpol Plant and its surrounding land uses. We will also document the status of Omya's noise mitigation efforts, and the likely feasibility of attenuating noise to the satisfaction of nearby residents. The intent is to present all this information in our Section 5 final report.

References

- Schneider, S., Gembardt, C. and van Ravenzwaay, B. (Study completed on May 26, 2003; report unpublished). N-(2-Aminoethyl)ethanolamine — Reproduction/developmental toxicity screening test (SIDS) in Wistar rats, oral administration (gavage). BASF Experimental Toxicology and Ecology Laboratory, Rhein, Germany. Laboratory Project Identification # 90R0019/01075.
- Silva, A., Wang, J., Pierson, R., *et al.* (2007). Extracellular water across the adult lifespan: reference values for adults. *Physiol. Meas.* 28:489-502.
- U.S. EPA (1997). *Exposure Factors Handbook*. Available at <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=12464>