Letter Health Consultation

FOUNDRY SLAG USED FOR ROAD ROCK

WASHINGTON COUNTY, IOWA

AUGUST 28, 2008

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

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WASHINGTON COUNTY, IOWA

Prepared By:

Iowa Department of Public Health
Under Cooperative Agreement with
The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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June 11, 2008

Kurt R. Levetzow
Environmental Specialist Senior
Iowa Department of Natural Resources
1023 W. Madison
Washington, IA 52353

RE: Health Consultation
Foundry Slag Use for Road Rock

Dear Mr. Levetzow:

This letter has been prepared as a consultation to evaluate whether any adverse health effects may occur from the use of foundry slag for road rock.

Background and Statement of Issues

A resident within one of the counties in your region has expressed some concern regarding potential adverse health effects from dust and material that may be found within foundry slag that has been used as a replacement for road rock. This consultation includes a comparison of nuisance issues from dust generated from a road constructed of foundry slag and dust generated from a road constructed from typical road rock. This consultation also includes a discussion of the potential health effects of exposure of heavy metals from incidental ingestion of foundry slag.

Discussion – Dust Nuisance Issues

The information from the local county engineer's office that was provided for review indicates that the foundry slag material used for road rock has a smaller percentage of finely-sized particles than typical or Class "A" road rock (1). The tests completed by the county engineer's office indicated that approximately 2 percent of the of the foundry slag material passed through a 200-mesh sieve. Material passing through a 200-mesh sieve would be smaller than 75 micrometers. Class "A" road rock can typically contain up to 15 percent of material that passes through a 200-mesh sieve. Since the foundry slag material has a small percentage of finely-sized particles it would be expected that smaller amounts of fine dust particles would be generated by foundry slag applied to roads than by typical road rock. This may result in less of a general nuisance issue than typical road rock.

Discussion – Incidental Ingestion of Foundry Slag

Another concern from exposure to foundry slag used as road rock would be the potential for ingestion exposure to small amounts of heavy metals that can be present within the foundry slag. You provided

results from analytical testing of the total metal content of the foundry slag. The following table is a summary of the maximum concentration of metals found within the foundry slag from the analyses completed.

Table 1 – Concentration of Total Metal Concentration with Foundry Slag (1)

Metal Constituent	Concentration (mg/kg)
Antimony, total	ND
Arsenic, total	ND
Barium, total	150
Beryllium	ND
Boron, total	84
Cadmium, total	ND
Chromium, total	340
Copper, total	70
Iron, total	28,000
Lead, total	13
Manganese, total	3,900
Mercury, total	ND
Molybdenum, total	19
Nickel, total	20
Selenium, total	ND
Silver, total	ND
Thallium, total	ND
Vanadium, total	89
Zinc, total	120

ND means not detected by the laboratory analytical method

A comparison can be made to the levels of metals within the foundry slag to levels of metals found within soil that have the potential of causing adverse health impacts to individuals. The Agency of Toxic Substances and Disease Registry (ATSDR) has calculated a set of comparison values for substances that may be found in air, water and soil. Comparison values (environmental guidelines) are substance concentrations set well below levels that are known or anticipated to result in adverse health effects. The following table is a list of available comparison values for some of the metals found in the foundry slag.

Table 2 – Comparison Values for Metals within Soil (2)

Metal	Comparison Value (mg/kg)	Exposure Frequency	Person
Barium	10,000	Chronic	Child
	100,000	Chonic	Adult
	400	Intermediate	Pica Child
Boron	10,000	Intermediate	Child
	100,000	Intermediate	Adult
	400	Intermediate	Pica Child
Chromium	200	Chronic	Child
	2,000	Chronic	Adult
Copper	500	Intermediate	Child
	7,000	Intermediate	Adult
	20	Acute & Intermediate	Pica Child
Lead	400*	Chronic	Child
Manganese	3,000	Chronic	Child
	40,000	Chronic	Adult
Molybenum	300	Chronic	Child
	4,000	Chronic	Adult
Nickel	1,000	Chronic	Child
	10,000	Chronic	Adult
Vanadium	200	Intermediate	Child
	2,000	Intermediate	Adult
Zinc	20,000	Chronic	Child
	200,000	Chronic	Adult
	600	Intermediate	Pica Child

"Chronic" exposure is for longer that 1 year
"Intermediate" exposure is between 14 days and 1 year
"Acute" exposure is up to 14 days
"Pica Child" is a child beyond the age of 18 months that exhibits a behavior of eating non-food items such as soil
* EPA's screening level for lead in residential soils

The concentration of several of the metals in the foundry slag is greater than at least one of the comparison values shown in the table on the previous page. These metals, their concentrations and corresponding comparison value are as follows:

Chromium at 340 mg/kg (CV = 200 mg/kg for chronic exposures to children)
Copper at 70 mg/kg (CV = 20 mg/kg for acute or intermediate exposure to Pica children)
Manganese at 3,900 mg/kg (CV = 3,000 mg/kg for chronic exposures to children)

In order to determine potential health effects from ingestion exposure to this foundry slag dust a closer look at the toxicological information and likely exposure is needed. A toxicological evaluation can be made utilizing assumed information on incidental ingestion of dust from living adjacent to a deposit of foundry slag and then comparing the estimated ingested amount of each metal of concern to studies showing actual health effects. According to ATSDR's Public Health Assessment Guidance Manual (3) it is estimated that an average adult may incidentally ingest up to 100 mg/day of soil and dust from various sources. According to the same guidance manual, it is estimated that a child exhibiting Pica behavior may ingest up to 5,000 mg/day of soil.

When considering the exposure of foundry slag to a child exhibiting Pica behavior, it is necessary to assume that a significant amount of foundry slag from the road would need to be deposited in areas where the child plays, and then this child would have to ingest significant amounts of this foundry slag by direct ingestion. A determination of the potential health effects from this type of exposure scenario will be made even though this type of exposure scenario would be unlikely.

Health Effects from Chromium Exposure

The lowest level of oral exposure to chromium that has been found to produce adverse health effects from evaluating human health studies completed on chronic oral exposure to chromium is 0.57 mg/kg/day (4). If we assume that an adult would ingest 100 mg/day of soil containing chromium at a concentration of 340 mg/kg, the amount of chromium ingested on a daily basis would be determined by the following equation:

$$\frac{340 \text{ mg chromium}}{\text{kg soil}} \times \frac{100 \text{ mg soil}}{\text{day}} \times \frac{1}{70 \text{ kg}} \times \frac{1 \text{ kg soil}}{10^6 \text{ mg soil}} = 0.00049 \text{ mg/kg/day}$$

The estimated amount of chromium that would be incidentally ingested by an adult exposed to foundry slag is over 1,000 times lower than the lowest amount of chromium shown to produce adverse health effects in human health studies.

Using a similar equation to the one above, estimation can be made of the amount of chromium ingested by a child exhibiting Pica behavior:

$$\frac{340 \text{ mg chromium}}{\text{kg soil}} \times \frac{5{,}000 \text{ mg soil}}{\text{day}} \times \frac{1}{15 \text{ kg}} \times \frac{1 \text{ kg soil}}{10^6 \text{ mg soil}} = 0.11 \text{ mg/kg/day}$$

The estimated amount of chromium that would be incidentally ingested by a child exhibiting Pica behavior exposed to foundry slag is roughly 5 times lower than the lowest amount of chromium shown to produce adverse health effects in human health studies.

Health Effects from Copper Exposure

The lowest level of oral exposure to chromium that has been found to produce adverse health effects from evaluating human health studies completed on intermediate oral exposure to copper is 0.091 mg/kg/day (5). There are no good chronic studies on human exposure to copper. If we assume that an adult would ingest 100 mg/day of soil containing copper at a concentration of 70 mg/kg, the amount of copper ingested on a daily basis would be determined by the following equation:

$$\frac{70 \text{ mg chromium}}{\text{kg soil}} \times \frac{100 \text{ mg soil}}{\text{day}} \times \frac{1}{70 \text{ kg}} \times \frac{1 \text{ kg soil}}{10^6 \text{ mg soil}} = 0.0001 \text{ mg/kg/day}$$

The estimated amount of copper that would be incidentally ingested by an adult exposed to foundry slag is roughly 900 times lower than the lowest amount of chromium shown to produce no adverse health effects in human health studies.

Using a similar equation to the one above, estimation can be made of the amount of copper ingested by a child exhibiting Pica behavior:

$$\frac{70 \text{ mg copper}}{\text{kg soil}} \times \frac{5{,}000 \text{ mg soil}}{\text{day}} \times \frac{1}{15 \text{ kg}} \times \frac{1 \text{ kg soil}}{10^6 \text{ mg soil}} = 0.023 \text{ mg/kg/day}$$

The estimated amount of copper that would be incidentally ingested by a child exhibiting Pica behavior exposed to foundry slag is roughly 4 times lower than the highest amount of copper shown to produce adverse health effects in human health studies.

Health Effects from Manganese Exposure

The highest level of oral exposure to manganese that has been found to not produce any adverse health effects from evaluating human health studies completed on chronic oral exposure to manganese is 0.059 mg/kg/day. If we assume that an adult would ingest 60 mg/day of soil containing manganese at a concentration of 3,900 mg/kg, the amount of copper ingested on a daily basis would be determined by the following equation:

$$\frac{3{,}900 \text{ mg manganese}}{\text{kg soil}} \times \frac{100 \text{ mg soil}}{\text{day}} \times \frac{1}{70 \text{ kg}} \times \frac{1 \text{ kg soil}}{10^6 \text{ mg soil}} = 0.0056 \text{ mg/kg/day}$$

The estimated amount of manganese that would be incidentally ingested by an adult exposed to foundry slag is roughly 10 times lower than the lowest amount of manganese shown to produce adverse health effects in human health studies.

Using a similar equation to the one above, estimation can be made of the amount of manganese ingested by a child exhibiting Pica behavior:

$$\frac{3{,}900 \text{ mg manganese}}{\text{kg soil}} \times \frac{5{,}000 \text{ mg soil}}{\text{day}} \times \frac{1}{15 \text{ kg}} \times \frac{1 \text{ kg soil}}{10^6 \text{ mg soil}} = 1.3 \text{ mg/kg/day}$$

The estimated amount of manganese that would be incidentally ingested by a child exhibiting Pica behavior exposed to foundry slag is roughly 20 times higher than the lowest amount of manganese shown to produce adverse health effects in human health studies.

Manganese is an essential nutrient and exposure to low levels can be considered to be beneficial. The National Research Council recommends that a 1 year old child can have up to 1 mg/day and a 10 year old child can have up to 2 mg/day of manganese (6). Assuming average weights of children these recommended amounts would equate to a dose between 0.05 and 0.09 mg/kg/day. The estimate amount of manganese that would be ingested by a child exhibiting Pica behavior exposed to foundry slag is higher than a recommended dose for manganese.

Conclusions

The foundry slag material used for road rock has a smaller percentage of finely-sized particles than typical Class "A" road rock. Therefore, the foundry slag material may have a lower potential of causing general nuisance problems than material that would normally be used for road rock.

The level of heavy metals found within the foundry slag is fairly small. The level of metals found within the foundry slag is not expected to produce any adverse health effects in adults or non Pica children that would incidentally ingest foundry slag dust (**No Apparent Public Health Hazard**).

Individuals that may be potentially adversely affected by the foundry slag would be children living near the road with the foundry slag that exhibit Pica behavior and may routinely ingest large amounts of foundry slag from near the road. But as previously stated, in order for a child to be exposed to large amounts of foundry slag a significant amount of foundry slag from the road would need to be deposited in areas where the child plays, and then this child would have to ingest significant amounts of this foundry slag by direct ingestion. It is concluded that this exposure scenario would be very unlikely and, as a result, adverse health effects from exposure to roads constructed of foundry slag would not pose significant adverse health effect even for children who may exhibit Pica behavior (**No Apparent Public Health Hazard**).

Recommendations

It is recommended that dust suppression measure be implemented to respond to any nuisance issues with dust. Children should be kept from playing near the road for their own safety and to control contact with the foundry slag. Other protective measures such as hand washing, toy washing, and restricting young children from eating outdoors can be implemented to control incidental ingestion exposure.

References

1. Information provided by Kurt Levetzow, IDNR Field Office 6.
2. Agency for Toxic Substances and Disease Registry. Soil Comparison Values. Atlanta: US Department of Health and Human Services; February 2008.
3. Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual – Appendix F, ATSDR web link: http://www.atsdr.cdc.gov/HAC/phamanual/appf.html
4. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Chromium. Altanta: US Department of Health and Human Services; September 2000.
5. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Copper. Altanta: US Department of Health and Human Services; September 2004.
6. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Manganese. Altanta: US Department of Health and Human Services; September 2000.

If you have any questions regarding the information in this letter please contact me at (515) 281-8707 or by email at sschmitz@idph.state.ia.us.

Sincerely,

Stuart C. Schmitz, M.S., P.E.
Principal Investigator / Environmental Toxicologist
Hazardous Waste Site Health Assessment Program

CERTIFICATION

The Iowa Department of Public Health, Hazardous Waste Site Health Assessment Program, has prepared this health consultation for the evaluation of foundry slag used as road rock under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The document is in accordance with approved methodology and procedures existing when the health consultation was being prepared.

Technical Project Officer, CAT, SPAB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

Team Lead, CAT, SPAB, DHAC, ATSDR