TECHNICAL BULLETIN

Standards Development Branch

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EMISSION FACTORS FOR 1,6-HEXAMETHYLENE DIISOCYANATE (HDI) EMISSIONS FROM SPRAY BOOTH OPERATIONS

EXECUTIVE SUMMARY

In cooperation with the suppliers and users of isocyanates, the Ontario Ministry of the Environment (MOE) initiated a study of 1,6-Hexamethylene Diisocanate (HDI) emissions with a focus on spray booth operations in the automotive industry. The primary objective of the study was to develop reliable emission factors for spray booth operations. The study had three distinct phases. These included the development of the experimental design, then the on site measurement and analytical work which was followed by an evaluation of the test results and development of emission factors.

A stakeholder coordinating committee was established with a terms of reference. This committee included representatives from the automotive industry, paint suppliers and other users of the product. The committee as a whole developed the experimental design. The objective of the experimental design was to develop testing scenarios that would mimic actual operating practices in the auto body and original equipment manufacturing sectors. Site measurement and analytical work were conducted at sites of committee members who participated in the project. The Ontario Ministry of the Environment (MOE) Standards Development Branch (Technology Standards Section) witnessed the testing. The ministry also retained a consultant to act as Peer Review for the study as well as to provide comment on the emission factors developed.

Emissions factors have been developed for three (3) operating conditions as outlined in the table below. Due to the limited number of tests performed during the study and the number of physical factors that could affect the emissions no definitive conclusions can be made on the effect on HDI emissions by the following:

- Quality of filters;
- Age of filters;
- Size of paint job; and
- Transfer efficiency of the painting process

Table 1: Summary of HDI Emission Factors and Ratings (units: g HDI emitted/kg HDI sprayed)

Operating Conditions [2]	HDI Monomer Emission Factor [4] CAS # 822-06-0	HDI Polyisocyanate[1] Emission Factor CAS # 28182-81-2	Emission Factor Ratings[3]
Autobody Sector using Best Management Practices	**76**	**48**	**C**
Autobody Sector using Historical Practices	**81**	**63**	**C**
Original Equipment Manufacturer Sector	**35**	**18**	**D**

Table 1 is a summary of the HDI emission factors from the study. It contains 4 columns and one header row. The first column lists the Operating Conditions, the second column includes the HDI emission factor, the third column includes the HDI Polyisocyanate Emission Factor and the last column is the Emission Factor Ratings.

Table Notes:

[1] HDI Polyisocyanate CAS # 28182-81-2 also includes:

- HDI Biuret CAS # 4035-89-6
- HDI Isocyanurate CAS # 3779-63-3

[2] Operating Conditions Definitions

Autobody Sector using best management practices:

- Dry Filter Paint Booth (down draft or cross draft booths)
- High Efficiency Type Paint Spray System (HVLP) means equipment used for the application of automotive refinish coatings conforming to Section 3.4 Application Equipment of the Canadian Council of Ministers of the Environment (CCME) Guideline; “CCME Guideline” means the document entitled “National Standards and Guidelines for the Reduction of Volatile Organic Compounds from Canadian Commercial/Industrial Surface Coating Operations-Automotive Refinishing, October 1998, PN 1278", as amended, and published by the CCME;
- Approved Automotive Refinish Coatings means automotive refinish coatings that comply with the VOC content limits indicated in Section 3.2.1 VOC Content Limits of the National Standards; “National Standards” means the document entitled “National Standards for the Volatile Organic Compound Content of Canadian Commercial/Industrial Surface Coating Products Automotive Refinishing, October 1998, PN 1288" and published by the CCME;

Autobody Sector using historical practices:

- Dry Filter Paint Booth (down draft or cross draft booths)
- Old style Conventional Spray Systems
- Unspecified Refinish Coatings

Original Equipment Manufacturer Sector:

- Water Wash Paint Booth
- Electrostatic Type Paint Spray System

(3) Emission Factor Ratings Definitions

Ratings based on US EPA document "Procedure for Preparing Emission Factor Documents: EPA-454/R-95-015, November 1997"

C = Average. Emission factor is developed primarily from A, B and C rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.

D = Below Average. Emission factor is developed primarily from A, B and C rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population.

(4) Limitations of Emission Factors

As mentioned above due to the limited nature of the study general emission factors have been developed for the three (3) operating conditions. The limited data of the study does not allow for any "customization" of the emission factors (i.e. accounting for differences in paint transfer efficiencies between the test condition and emission factor users facility).

Auto body sector facilities with water wash paint booths should not use the emission factors derived for the original equipment manufacturer sector water wash booth as the operating conditions for the two types of facilities are very different. As no testing was performed on auto body sector water wash booths it is recommended that auto body facilities with water wash booths use the auto body sector dry filter emission factors according to the paint and spray systems used.

Most MSDS provide a range of potential concentrations for isocyanates in each specific paint component and most regulators would require the highest potential concentration to be used to calculate emission estimates using these emission factors. However, it may be possible to obtain actual concentrations from paint manufacturers, enabling the user to reduce the resulting emission estimate, while also improving its accuracy.

REFERENCES

This Technical Bulletin is derived from a study entitled: "Determination of 1,6-Hexamethylene Diisocyanate (HDI) Emissions from Spray Booth Operations Joint Ministry/Industry Study" dated April 2006. A copy of this document is available through the Ministry's Public Information Centre. Please call toll free at 1-800-565-4923 or (416) 325-4000 or visit http://www.ene.gov.on.ca/envision/techdocs/index.htm.