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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Review of Measurement of Poly(Hexamethylenebiguanide hydrochloride)[PHMB] in Cotton and Polyester/Cotton Cloths

To: Adam Heyward, Product Manager, Team 34
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DP Barcode: D268350 (S584006)

Pesticide Chemical
Name/No: Poly(Hexamethylenebiguanide hydrochloride, PHMB)/111801
Registration Case: 023188
MRID#: 451877-06

Introduction:

Avecia, Inc. has submitted a study on leaching of Poly(Hexamethylenebiguanide hydrochloride, PHMB) from 100% cotton and 35/65 polyester/cotton cloths. Avecia wants to register their product, VANTOCIL IB, in which PHMB is the active (20% a.i.), for use on apparel, items such as slacks, shirts, underwear, sweat shirts, sweatpants, socks, oven mitts, slippers, bathrobes, gloves, hats, scarves, diapers, and incontinence pad cover stock. These items are listed as examples. Obviously, all types of apparel items may be treated with PHMB.

Background:

According to the Technical Bulletin Information provided by Zeneca (previous applicant to the same product) along with the label, VANTOCIL IB is registered to be used as an "agent to control the growth and action of microorganisms, and control generation of odors, on textiles such as cotton, cotton blends, and cellulosic materials such as non-woven, tissues, paper and pulps." Furthermore, registered uses include textiles such as "household products, for example, upholstery, carpets, curtains, wall coverings, mops, dishcloths, yarns and toweling. And cellulosic materials such as: wipes, tissues, sponges, paper products (non-food contact) such as filters, and cellulose pulp."

VANTOCIL IB is applied to these and such products as a dilute solution between the ranges of 0.025 to 2.0% based on dry weight of the substrate. This is done between pH 6.5 to 8.0 and temperatures between 20-30 °C.

AD has carried out the estimation of Total Available Residues (TAR) for toddlers from incidental non-dietary ingestion of pesticide residues contained in cotton and polyester/cotton cloths impregnated with this pesticide.

Summary and Methodology:

The submitted leaching study was conducted according to the UK Principles of Good Laboratory Practice (UK/GLP Regulations, 1999). These principles, in turn, are based on OECD Principles of GLP, revised in 1997. The report was audited according to the internal (Avecia Policy and QA procedures for GLP) standards.

The PHMB-treated cloth samples were extracted into the Artificial Perspiration Simulant (ISO-105-E04 Method) and analyzed by using the Biocide Test Method (TM 87/715). The extraction (leaching) was carried out at pH 5.5 for four hours at temperatures $37^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The leachate containing PHMB was reacted with Eosin Dye to produce a colored intermediated (the reaction between PHMB and the Eosin Dye is 1:1) and PHMB/Eosin derivative was detected and quantified at 545 nm using a UV-VIS spectrophotometer. In general, about one gram of cloth samples were added to 10.0 ml Artificial Perspiration Simulant (APS).

For the analysis 1.0 g of cloth samples were used. Two types of cloth samples were analyzed:

- A. 100% cotton, treated with PHMB
- B. 35/65 cotton/polyester treated with PHMB

From type A, the amount of PHMB that leached was 560 ppm/ g of the cloth sample. This is the average of two samples.

From type B, the amount of PHMB that leached was 125 ppm/g of the cloth sample. This is the average of two samples.

The leaching from 100% cotton cloth sample was more than four times higher than that of the 35/65 cotton/polyester cloth sample. (See below).

Calculations:

Registrants have provided AD the following additional information (Nov.8, 2000) after the formal submission (Aug.10, 2000):

- 1. The estimated area/g of the of 100% cotton fabric: 73 cm²
- 2. The estimated area/g of the 35% polyester/65% cotton fabric: 52 cm²
- 3. 2% of Reputex 20 (this is the alternate name of Vantocil IB) was used for the analytical work. This is equal to 0.4% PHMB, since the product contains 20% a.i.

A. Assuming that both fabric samples have equal capacity to absorb PHMB, and assuming that an infant is exposed to 500 cm² of fabric, the amount of PHMB absorbed by a 500 cm² piece of fabric will be:

4. $500 \text{ cm}^2 \times 0.40\text{g}/100\text{g} = 2.0 \text{ g}$ 2000 mg

However, according to the leaching study, a 100% cotton fabric/g sample (pre-washed) leached: 560 ppm

5. Hence PHMB leaching (wt./area) from 100% cotton fabric: $560 \text{ ppm}/73\text{cm}^2$
= 7.67 $\mu\text{g}/\text{cm}^2$

If it is assumed that this is the amount of PHMB leaching out for the first week of the fabric use (prewashed). According to the leaching data, the amount of PHMB

that leaches from both 100% cotton and 35/65 polyester fabrics in the second week (post-washed) is $< 50\text{ppm}$

6a. Hence the amount of PHMB leaching from 100% post-washed fabric is:
$$50 \text{ ppm}/73\text{cm}^2 = \underline{0.69 \mu\text{g}/\text{cm}^2}$$

6b. From calculations in 6a, this amount can be approximated to $\underline{1 \mu\text{g}/\text{cm}^2}$

Hence the total weighted average of PHMB residues from leachates available from pre-washed(first week of use) and remaining 51 weeks post washed fabrics will be:

7. $[1 \times 7.67 + (51 \times 1)] \mu\text{g}/\text{cm}^2 / 52 \text{ weeks}/\text{year} = \underline{1.13 \mu\text{g}/\text{cm}^2/\text{year}}$

One can approximately calculate the Total Available Residues(TAR) for a given surface of a PHMB-impregnated piece of cloth by the following equation:

8.
$$\text{TAR} = \text{AR} \times \text{SA}$$

where: AR = Available Residues in the PHMB leachates from the fabrics.
and SA = surface area of impregnated material mouthed per day by an infant.

Again, if it is assumed that a fabric of 500 cm^2 is the area that an infant can possibly be exposed to, then using results from equation 7:

9.
$$\begin{aligned} \text{TAR} &= \underline{1.13 \mu\text{g}/\text{cm}^2 \times 500\text{cm}^2} \\ &= \underline{565 \mu\text{g}} \end{aligned}$$

Assuming a toddler weighs approximately 10 kg, then annualized exposure for this toddler, normalized to body weight will be:

10.
$$\text{TAR}/10\text{kg} = 565 \mu\text{g}/10 \text{ kg} = \underline{56.5 \mu\text{g}/\text{kg}}$$

Similar calculations for 35/65 polyester/cotton fabric, which showed a leaching rate of 125 ppm/g, yields Total Available Residues(TAR) for this toddler will be:

$$= \underline{513 \mu\text{g}}$$

If the toddler weight is assumed to be 10 kg, then annualized exposure, normalized to body weight will be:

11.
$$\text{TAR}/10 \text{ kg} = \underline{51.3 \mu\text{g}/\text{kg}}$$

Therefore, over a course of a year, a toddler may receive between 51.3-56.4 µg/kg of PHMB through mouthing cotton fabric (e.g bed sheet or a blanket) as non-dietary incidental ingestion.

RASSB Conclusions and Recommendations:

The present study of PHMB leaching from impregnated (100% cotton and 35/65polyester/cotton) fabrics was conducted based on ISO-105-E04 and Biocide Test Method (TM 87/715). RASSB concludes that the study is incomplete and deficient in providing sound scientific data and can not be accepted as a full study. RASSB recommends to accept the study as supplemental. Some deficiencies have been noted by RASSB and are discussed below:

a. The study was conducted on very few samples:duplicate washed and unwashed treated fabrics (100% cotton and 35/65 polyester/cotton fabrics). Statistically, such samplings do not give a range of the leachate concentrations. Moreover, cotton fabrics are available in all possible varieties: bleached, unbleached, glazed and unglazed cotton fabrics. Different varieties of cotton fabric are likely to have different leach rates and give rise to different TARs. No mention is made about the type of cotton fabrics chosen. Similarly, 35/65polyester/cotton fabrics can also be different in a number of ways as the chain length of the polyester units may vary and hence leachate concentrations may vary from one fabric product to another.

b. The analytical technique used to identify and quantify is not a very sensitive one. The limit of detection (LOD) is very high (50 ppm). Moreover, quantitation from colorimetric/spectrophotometric techniques is not a very sensitive and accurate method.

c. The leaching amounts for 100% cotton fabric appears much higher compared to 35/65 polyester/cotton fabric. No discussion was provided as to the reason for this difference.

Considering the above deficiencies, we recommend the registrants submit a more robust study, including a much higher number of samples, to the Agency for use in its exposure and risk determinations.

cc: Chemfile: 111801 (NShamim)