AMEM Questions and Answers

Q: Why is AMEM still in DOS? I have Windows, how do I run a DOS program in Windows?

A: The development of AMEM by the EPA was initiated in the mid 1980 and completed in 1989. The use of this model has been infrequent and since it provides only one parameter needed to estimate exposure, EPA plans to migrate AMEM to a Windows platform and will post an updated model when it is available.

To operate AMEM using Windows, click on "Start", "Run", and "Browse". Then, go to the directory where you downloaded AMEM to, double click on "AMEM.exe ", and click "run ". AMEM will open. Please note the active keys for all menu items are given on the bottom of the screen. The mouse does not work with AMEM. You must use the keys specified on the screen for navigating through the AMEM model (common example - "Press F1 to continue"). The user manual with specific instructions is provided in Chapter 6 of Methods for Assessing Exposure to Chemical Substances, Volume 11 - Methodology for Estimating the Migration of Additives and Impurities from Polymeric Materials, Sept. 1990.

Q: Where can I find information about how AMEM calculates the amount of chemical that migrates from polymers?

A: The model documentation and background is contained in Methods for Assessing Exposure to Chemical Substances, Volume 11 - Methodology for Estimating the Migration of Additives and Impurities from Polymeric Materials, Sept. 1990 which is available for downloading as a pdf file.

Q: What are the most important assumptions that are embedded within AMEM?

A: The mathematical algorithms developed for AMEM assume an ideal polymer-additive system that has the following properties:

- the polymer is a flat sheet of uniform thickness with no edges,
- Iinitially, the additive is homogeneously distributed throughout the polymer and there is no additive present in the external phase. The additive of concern is not affected by any other migration that may be occurring, swelling or penetration does not occur, or, if it does, it does not affect the physical dimensions appreciably nor does it affect the migration,
- the diffusion coefficient of the additive is a function only of tempeature and not of position or time,
- the migration is isothermal, and
- Fick's laws apply.

Q: Has AMEM been peer reviewed?

A: Yes. An external (i.e., by scientists outside of EPA) peer review of AMEM was conducted in 1988. Revisions to the model in response to the peer reviewers' comments were completed in Sept, 1989.

Q: Has AMEM been evaluated to ensure that the model calculations are being done correctly and that the results are consistent with measured results?

A: Yes. The methods for estimating migration were evaluated by comparing predictions generated with the AMEM computer program with those measure experimentally. Table B-1 in Appendix B of Volume 11 summarizes thirteen cases evaluated. In most of the cases, the agreement between the model and the experimental results was within an order of magnitude. Those cases in which good agreement is not achieved appear to be in two categories. The first category is those migrants for which the diffusion coefficient (Dp) in the polymer is not known and the molecular weights (MW) are greater than those used to develop the Dp versus MW correlation. (See fig 5 and 6 of Vol. 11). For these migrants, it appears that the Dp predicted by AMEM is too low, especially in the case of rigid polyvinyl chloride . Another possibility is that the very low migration levels reported in some cases may be accounted for by release from the surface rather than a diffusional process. The second category involves migrants, such as an antioxidant, that migrate rapidly but have a low solubility and degrade in the external phase. In its present form, AMEM does not take into account chemical reaction of the migrating species.

Q: Does AMEM contain more than one polymer?

A: Yes. There are "default" coefficients for six different polymers: silicone rubber, natural rubber, LDPE (Low Density Polyethylene), HDPE (High Density Polyethylene), polystyrene, and unplasiticized PVC (Polyvinylchloride).

Q: The polymer I want to model is not on the list. Can I use AMEM for my polymer?

A: You can use AMEM if you have a diffusion coefficient for the polymer you are interested in. Keep in mind that there are underlying assumptions that Fick's laws of diffusion and mass transfer theory applies.

Q: Can I use AMEM to estimate the fraction of chemical emitted from nonhomogeneous materials such as sponges or mattresses?

A: AMEM assumes that the material is homogenous, therefore it is not valid for materials such as sponges and most foam such as that used in mattresses. It is possible that diffusion coefficients for these types of materials may be found in the literature. If not, testing would be required to determine the diffusion of chemicals in these types of polymers.

Q: How Does AMEM Work?

A: AMEM is a DOS-based software product developed in 1989 that uses a family of mathematical equations that address simple and complex scenarios for chemical migration through a specific polymer. The more complex equations require more input data. Using the model, you may:

- Develop migration estimates,
- Consider the effect of chemical partitioning between the polymer and the external phase,and
- Consider the effect of mass transfer resistances in the external phase.

In all cases the model estimates the fraction migrated (i.e., the fraction of the chemical initially present in the polymer that migrates) after a specified duration. This model only provides one parameter needed to estimate exposure. The user must then use other equations and/or models to estimate exposure.

Q: What Do I Need to Use AMEM?

A: Polymer category (i.e., Silicone Rubber, Natural Rubber, LDPE, HDPE, Polystyrene, or unplasiticized PVC) or diffusion coefficient of the polymer.

- Molecular weight of additive.
- Total polymer sheet thickness (cm) External phase (i.e., air, water, or solid)
- One or two sided migration Time frame of interest

Q: What Type of Computer System Do I Need?

- Processor - IBM-compatible computer with a Pentium microprocessor (minimum speed: 33 MHZ)
- Memory - 640K
- Hard disk space - 2 MB
- Operating System - AMEM is a DOS-based program, however, in can be run in a Windows environment by using key strokes not a mouse.

Q: What is AMEM's Status and Availability?

AMEM is available as a DOS program . The model has been peer reviewed by experts outside EPA. AMEM was developed by Arthur D. Little Inc. under a subcontract with Versar, Inc. for the EPA Office of Pollution Prevention and Toxics, Economics, Exposure, and Technology Division, Exposure Assessment Branch (EAB).

EPA is scoping out conversion of DOS version of AMEM into Excel. A newer model I-SVOC also estimates migration of additives from polymeric matrices, among other processes.