



Designation: E 895 – 89 (Reapproved 1995)

Standard Practice for Determination of Hydrolysis Rate Constants of Organic Chemicals in Aqueous Solutions¹

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1. Scope

1.1 This practice describes specific procedures for obtaining solution hydrolysis rate constants and half-lives of organic chemicals that may enter the aquatic environment.

1.2 Solution hydrolysis data are obtained in sterile, buffered water using laboratory studies in which the concentration of a chemical as a function of time is measured.

1.3 A four-tiered approach is described. The testing procedures are designed to provide basic and easily obtainable information in the first tier. More detailed and costly experiments are proposed in subsequent tiers. This approach is more cost effective than one which provides for no sequential assessment.

1.4 Since all details are not covered in this practice, successful execution of the described tests will require some training or experience in the area of hydrolysis. Familiarity with the material in the references is essential.

1.5 This practice describes laboratory studies. It is not designed to provide data directly applicable to the environment. Extrapolations to specific environmental situations may require additional data or tests not included in this practice.

1.6 This practice does not consider the possible hydrolytic influences of dissolved organic matter or of adsorption/catalysis by suspended material.

1.7 This practice is written to minimize competitive processes such as oxidation, reduction, substitution, and microbial reactions.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 Definitions:

2.1.1 *half-life*—the time required for the chemical concentration to decrease to half its initial value (see section 7.2.4).

2.1.2 *hydrolysis*—any reaction that takes place in water, in

the absence of light and microorganisms, in which the compound is transformed to a different compound as the result of a reaction with water.

2.1.3 *rate constant*—see 7.2.3.

3. Summary of Practice

3.1 This practice consists of separate tests arranged in a tier or hierarchal system. The testing procedures are designed to provide hydrolysis information in a cost effective manner. Basic and easily obtainable information will result from the first tier. The higher tiers are more stringent and provide additional information. Progression guidelines are provided so that a testing program can proceed from one tier to the next when additional data are desirable.

3.2 *Tier 1*—A study is performed on the chemical at $50 \pm 1^\circ\text{C}$ in acidic (pH 5) and basic (pH 9) solutions. These conditions are designed to provide an accelerated test procedure. Since the rate of hydrolysis increases with temperature, the rate constant measured at 50°C will always be greater than that at 25°C . If less than 10 % hydrolysis is detected after seven days, at both acidic and basic pH levels, the chemical is considered hydrolytically stable and no additional testing is required. If hydrolysis is detected and additional information is desired, proceed to Tier 2.

3.3 *Tier 2*—The rate of hydrolysis is determined in acidic, neutral, and basic solutions. One incubation temperature and one chemical concentration is used to determine a pseudo first order rate constant.

3.4 *Tier 3*—The rate of hydrolysis is determined in acidic, neutral, and basic solutions. Three incubation temperatures and two concentrations are used to define kinetic rate expressions and corresponding rate constants. Progression to Tier 3 is dependent on an estimation of the importance of hydrolysis relative to other degradation processes in the environment; greater precision and additional kinetic data such as Arrhenius parameters (activation energies and frequency factors) may be of interest.

3.5 *Tier 4*—Hydrolysis products are characterized if hydrolysis is expected to be important under environmental conditions.

4. Significance and Use

4.1 Hydrolysis is one of several factors which may influence the degradation of organic chemicals in the environment.

¹ This practice is under the jurisdiction of ASTM Committee E-47 on Biological Effects and Environmental Fate and is the direct responsibility of Subcommittee E47.0 on Environmental Fate of Chemical Substances.

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