IN-LB	Inch-Pound Units
SI	International System of Units

Hazardous Material Containment in Concrete Structures—Report

Reported by ACI Committee 350

ACI PRC-350.2-21

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This report presents recommendations for structural design, materials, and construction of structures commonly used for hazardous materials containment, including reinforced concrete tanks, sumps, and other structures that require dense, impermeable concrete with high resistance to chemical attack. The report discusses and describes design and spacing of joints, proportioning of concrete, placement, curing, and protection against chemicals. Information on liners, secondary containment systems, and leak-detection systems is also included.

Keywords: chemical protection; liner; construction joint; containment systems; gas-tight; hazardous materials; joint sealant; liquid-tight; precast concrete; prestress; water-cementitious materials ratio; waterstop.

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ACI PRC-350.2-21 supersedes ACI 350.2R-04 and was adopted and published October 2021.

CHAPTER 1—GENERAL

1.1—Scope

This report provides guidance for the design and construction of hazardous material containment systems involving reinforced concrete construction. Hazardous material containment structures require secondary containment and, sometimes, leak-detection systems. Because of the economic and environmental impact of even small amounts of leakage of hazardous materials, both primary and secondary containment systems should be virtually leak-free. Therefore, when primary or secondary containment systems involve concrete, special design and construction techniques are required. This report supplements and enhances the requirements of ACI 350, Code Requirements for Environmental Engineering Concrete Structures, which is intended for structures commonly used in water containment, industrial and domestic water and wastewater treatment works. ACI 350, however, does not give specific guidance on the design of the double containment systems, leak-detection systems, or the additional recommendations for enhancing liquid-tightness covered in this report. This report does not apply to primary or secondary containment of cryogenic liquids, nonliquid materials, or to systems containing radioactive materials. This document does not cover material storage requirements or environmental impacts of leaching.

The use of information in this report does not ensure compliance with applicable regulations. The recommendations in this report are based on the best technical knowledge available at the time they were written; however, they may be supplemented or superseded by applicable local, state, and national regulations. Therefore, it is important to research such regulations thoroughly. (Refer also to Section 8.1.)

Guidelines for containment and leakage-detection systems given in this report involve combinations of materials that may not be readily available in all areas. Therefore, local distributors and contractors should be contacted during the design process to determine what materials are available.

Thorough inspection of construction is essential to ensure a quality final product. The written program for inspection should be detailed and comprehensive and should be clearly understood by all parties involved. See Section 4.3 for an inspection checklist. (Refer to ACI 311.4R for guidance in inspection programs.) A preconstruction conference to discuss the program in detail is recommended. Personnel should be qualified, experienced, and certified as applicable to their specialty.

1.2—Definitions

Please refer to the latest version of ACI Concrete Terminology for a comprehensive list of definitions. Definitions provided herein complement that resource.

ancillary equipment—ancillary equipment includes piping, fittings, valves, and pumps.

coating—a very low permeability barrier material that is bonded to the concrete and that is used to prevent fluid (or gas) migration through the concrete.

hazardous material—a hazardous material is defined as having one or more of the following characteristics: ignitable, corrosive, reactive, or toxic.

NOTE: The U.S. Environmental Protection Agency (EPA) listed wastes are organized into three categories under the Resource Conservation and Recovery Act (RCRA): source-specific wastes, generic wastes, and commercial chemical products. Source-specific wastes include sludges and wastewaters from treatment and production processes in specific industries such as petroleum refining and wood preserving. Generic wastes include wastes from common manufacturing and industrial processes such as solvents used in degreasing operations. Commercial chemical products consist of chemicals such as benzene, creosote, mercury, and various pesticides. Hazardous materials are considered to include liquids that are a classified as a physical hazard, health hazard, or hazard not otherwise classified, each as defined herein. The Code of Federal Regulations (CFR) Title 40—Protection of Environment, Part 261 Identification and Listing of Hazardous Waste may also be helpful in identifying categories of hazardous materials pertaining to this document.

health hazard—a chemical classified as posing one of the following hazardous effects: acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); or aspiration hazard.