Innovative Design for Manure Storage Facilities

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Abstract Hog manure storage is a major constraint to confined animal production systems. Expanding levels of production, particularly in hog industry, are making this problem more severe. In the past, liquid manure has commonly been stored in earth lagoons. Increasing environmental concerns relating to ground seepage have led to the requirement that more impervious structures be designed and built. This has augmented the use of steel reinforced concrete for manure storage tanks above ground. The challenge of reinforced concrete is its long-term stability, which controls so-called durability or service life of concrete structures. Due to the hostile service environment (i.e., the presence of low pH, salts, and moisture) associated with manure storage, corrosion rates of the steel reinforcement are high. These deterioration rates can lead to relatively short service life of the manure storage tanks. This paper investigates the suitability of innovative design procedures for reinforced concrete hog-waste manure storage tanks using fiber Reinforced Polymers (FRP) as the internal or external reinforcing element. The work is focused on steel rebar (the reinforcement polymers (GFRP) that are the least expensive and have a great potential to significantly improve the service life of the manure tanks. The GFRP materials under investigation are the GFRP C-BAR™. GFRP ISOROD and GFRP spray composite. Three experimental structural designs are being investigated. In the first design, the reinforced concrete specimens are not covered with any protective materials, whereas FGRP composite was used in coating the reinforced concrete specimens in the second design. The third design involves covering the concrete specimens with PVC plates. The first design is used to evaluate the relative effectivene3ss of steel and FGRP as internal reinforcing elements in hog manure environment. The last two designs are being used to determine the behavior and protective capacities of the PVC cover (material that is used in the construction of cast-in-place OCTAFORM reinforced concrete manure tanks) and GFRP spray cover as external protection for reinforced concrete in manure storage tanks. The effects of exposure time (4, 8, 12, 24 months) and exposure conditions such as maintaining the relatively high initial aggression of manure (i.e. the manure in the experimental tanks is changed after each wet/dry cycle) and wet/dry cycle (15 days exposure to manure and 15 days exposure to air at room temperature) on the physical and mechanical properties (compressive, tensile and flexural strengths) are investigated on each structural design. The paper summarizes and discusses the results obtained after 4 and 8 months exposure to hog manure.