Sedimentation Tanks through the Ages


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Abstract: It is generally thought that sedimentation tanks are a fairly new technology in wastewater treatment dating from the middle of the 19th century. However, archaeological excavations have revealed sedimentation tanks that were being used from ancient civilizations like the Minoan or more recent ones such as the Roman for the settling of solids and impurities in wastewaters, streamwaters, and stormwaters.

Keywords Minoan; Roman; sedimentation tanks; wastewater.

Introduction

Primary treatment of wastewater is usually carried out through primary sedimentation, which refers to the quiescent detention of wastewater in a specially designed settling tank to remove settleable and floating solids. “Settling tanks,” “sedimentation basins,” and “clarifiers” are considered equivalent terms and can be used interchangeably. There are three main functions of sedimentation tanks: (a) Remove solids (sludge) from liquid by sedimentation, (b) remove solids (scum, grease, and floating debris) from liquid by flotation, and (c) thicken solids for removal and subsequent processing.

The primary treated effluent can undergo further treatment (secondary or biological) or it can be used, under specific circumstances, for a variety of purposes such as irrigation. Today there are two main types of sedimentation tanks: circular or rectangular, whilst the square and stacked types are less common (Water Environment Federation, 1996).

It is generally believed that sedimentation tanks are a fairly new technology in wastewater treatment dating from the middle of the 19th century. However, there are significant indications that sedimentation tanks, or at least some forms of them, had been employed from the ancient times and can be dated as far back as the Roman times or even earlier, in 1700 B.C. during the Minoan Civilization and were used for a variety of purposes such as settling of impurities in spring water or even wastewater and stormwater treatment and reuse.

Evolution of Sedimentation Tanks through the Ages

Ancient world (2500 B.C. – 1390 B.C.)

The need for waste and wastewater management strategies begun rising only after the nomadic tribes were starting to settle down and forming communities that would occupy a certain territory instead of moving from one place to another. Cities of the Indus Valley from 2500 B.C had houses with bathrooms with water flushing toilets and well-designed drainage systems (Kahn, 2000).

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The Minoan Civilization on the Island of Crete between 1700 – 1500 B.C. had a highly developed waste management system. They had very advanced plumbing and designed places to dispose of organic wastes. Knossos, which was the capital city, had baths that were filled and emptied using terra-cotta pipes. They had flushing toilets, with wooden seats and an overhead reservoir. Excavations revealed four large separate drainage systems that emptied into large sewers built of stone. The stormwater sewerage system found in the outer stairway of the northwest wing of Knossos Palace was one of the most advanced techniques practiced in Minoan Crete (Evans, 1964, Angelakis et al., 2004). On the one side of the stairway there is a small open sewer that follows the parabolic flow path (Figure 1) instead of the line of the stairs in order to avoid any erosion and nuisance to the people using the stairs as the stormwater flows downwards (Angelakis et al., 2004). The further arrangements of these channels were little tanks, like small sedimentation tanks, placed at proper intervals to allow it to settle to the bottom and freeing the stormwater from impurities so that it could be used for washing or other purposes.

Figure 1 Palace of Knossos: Stairway with a parabolic flowpath on the side leading to a small settling tank.

One of the most advanced Minoan sanitary and storm sewer systems was discovered in Hagia Triada (Angelakis et al., 2004) 60 km southwest of Knossos palace. Researchers that visited the excavated sites and inspected the sewer system could witness that all the sewers were still functioning perfectly, after 4000 years of their construction. The sewers were leading to large (1.5 x 2 m²) stone-built sedimentation tanks (Fig. 2) that were used for the settling of the wastewater and the removal of gross solids and floating debris.

Figure 2 Sedimentation tank discovered in Hagia Triada.
Another remarkable case of sedimentation tank in Late Minoan period (1425-1320 B.C.) was found in Minoan Tylissos, 14 km west of the palace of Knossos. A network of clay pipes was excavated by Joseph Chatzidakis in 1902-1913 that carried the water of the spring of Agios Mamas, which even today is the water source of the village. The clay pipes led to a sedimentation tank (Fig. 3) that slowed the flow of the spring water and allowed any large particles and impurities to settle.

![Figure 3 Sedimentation tank found in Tylissos.](image)

**Roman times**

Ancient Rome had eleven major aqueducts, built between 312 B.C. (*Aqua Appia*) 226 A.D. (*Aqua Alexandrina*), which were the first real artificial rivers that provided water for entire cities. Aqueducts were channels bored through the rock from the water intake in the hills almost to the distribution cistern in Rome (www.informa.it/aqueduct). The depth of the channel below ground varied so as to maintain a constant and shallow gradient through the length of the aqueduct. Along each channel, at particular points there were sedimentation tanks where the flow of the water slowed down and impurities were deposited. According to Hodge (2002), settling tanks were also found along the main stretches of the aqueduct, though they occurred more often near the beginning (Fig. 4), to clear the water on leaving the springs, or near the terminal *castellum* and the urban network.

![Figure 4 Layout and photo of Grüne Pütz, the start of the aqueduct at Cologne, Germany.](image)
On the aqueduct at Siga, in Algeria, there was a series of at least twenty small basins, which varied in shapes; some were oval and some others round with 1 m³ capacity. The normal form however was a barrel – or a cross-vaulted chamber or set of chambers – through which the water made its way (Hodge, 2002). In any case the importance of the settling may be gauged from the pebbles found in the settling tank of the Anio Novus at the Villa Bertone, shortly before its entry into Rome where the pebbles are a size of a pea and completely round.

During the Roman times Gortyn was the capital of Crete. Gortyn had initially one major aqueduct which was put out of use following repeated catastrophes and subsequent rebuilding, until a new water-supply system with three built aqueducts leading to the city was established in the 6th century A.D. Recent studies have provided us with a picture of the system of water supply in the city dating to the Late Roman and Early Byzantine periods. The basin that is shown in Figure 5 is thought to be the ruins of a settling tank that was built during the course of the water that flowed from the aqueduct to the city.

![Figure 5 Remains of a settling tank found in Gortyn.](image)

### Middle Ages and Renaissance

Around 500 A.D. during the middle ages, the practice of separating drinking water and human wastes was abandoned and human wastes could easily migrate from pits into wells. As Kahn (2000) states, “the taps were being turned off all over Europe and they would be turned on again nearly a thousand years later: Sanitation technology entered its dark ages”. As the Middle Ages were passing, certain changes started taking place and during the Renaissance more concern was given to health and water issues. It was during the Renaissance when the cesspool was developed. Cesspool was not a typical septic tank but it was employed for the same purpose and it can be described as a simple pit, which allowed solid to settle and the liquid to seep directly into the soil. However, the solids were not as efficiently decomposed as in regular septic tank and more frequent cleaning was necessary (Burks and Minnis, 1994).

### References


