The water supply in ancient Greece  

Manuela Kramer

„The principle all of the things is the water,  
out of the water is all  
and into the water goes all the things back“

Thales of Milet, ca. 600 years before Christ

Abstract: The epoch of the ancient Greek extended from 600 to 100 years before Christ. The technology of constructions and material used was very important for durability and quality of water supply facilities. In the antique wood, stones, bricks or metal was used among other things. Besides that they used tools, machines, levers, rolls, blocks and pulleys, ships, wagons, carts and metal gearwheels. Hygienically aspects were taken into consideration since the Hellenistic era (323 until 31 years before Christ). Since that time sewage systems were known, built, and in use.

1. Supply of ancient towns

Special attention at the construction of water supply facilities was placed at the construction material and the technology. The most important and oldest materials were wood and stones. The construction with wood was limited to areas with forests and sparsely population. Wood as construction material was frequently used to build piles. The most solid, hardest and most permanent wood was oak. Also it was very spread to build with stones, because of its permanence and resistance. Besides that the ancient Greeks used bricks and metal as construction metal. Most of the pipelines in towns were reduced by bricks and clay. The pipelines could also be made of lead. But ancient time’s clay manufacture was easier and faster than metal manufacture. Metals were necessary to temper or to alloy other substances. Another application of metals was the manufacture of pins, hooks, clamps or dowels which were used to connect materials. The most important tools and machines were lever, roll, block and pulleys, carts, ships, rafts, cranks and
sledges. Also the hygienically aspects of the water supply were taken into consideration, since diseases are spread readily through sewage. The collected rain water spoils very fast. On this basis of the facts, at the beginning of the Hellenistic era (323 years before Christ) the rulers passed a lot of regulations to the cleanliness of the water and for the built of sewage systems. The use of water (mostly rain water or lake –and river water) was many-sided, in this era. In Figure 1 different possibilities to use water can be seen as well as time of use under historical aspects.

Fig. 1. Possibilities to use water in the ancient era (from Tölle-Kastenbein 1990)

The water supply of the antique was many-sided. In the following an exact and detailed insight of the greek water supply of the antique town Milet will be given.

2. The water supply of the antique town Milet

The town Milet was situated on the cost of the Mediterranean sea of today’s Turkey. Figure 2 shows a map of the Greek empire in the antique and the ancient Greek town Milet.
The town Milet is named after the philosopher Thales of Milet (624 until 546 years before Christ). At Milet’s time the hygienic and water-culture was very demanding. At the beginning of the archaic era the population increased very intense. In average, Milet had 40 000 inhabitants. Milet was climatically influenced by the Mediterranean Sea. At the hydrological aspect the precipitation quantity is very important for the water supply of Milet. Most of the precipitations were falling in December and January with 650mm in these months. In May until September the precipitations were very low. When we look at the geological situation, so we find that the aquifers are made of sands and gravels In Figure 3 shows the geological situation around Milet which is characterised by non-marine basement covered by lime stones and quaternary sediments forming good aquifers.
The water demand of Milet in its best times was 18 litres per inhabitants and day. By comparison an inhabitant of Germany uses 120 litres of water per day (in 2001). There were two possibilities to ensure the water supply of Milet: At the one hand the non central self-supply of the people and on the other hand the central communal supply. The first great systems for the water supply of big towns were built 500 years before Christ. But built cisterns and pipes were nevertheless used in regions with less precipitation. The self-supply of the people consisted of cisterns, pumping wells, leakage facilities, shaft pumping wells and spring settings.

### 2.1 Cisterns

The principle of cisterns is to collect and store rain water. Cisterns existent in different sizes, from 10 to 130 m³ water capacity. In ancient Greece private and public cisterns were known. Cisterns could as well be distinguished by use: cisterns for drinking water and cisterns for water being used for washing etc.. Above ground cisterns were often small, narrow and rectangular. They were protected against dirt and mud, by a small covering.

Often the subterranean cisterns were made from clay and stones and embedded in the ground or directly hewed in stones. These subterranean
cisterns are in the form of bottles, bells or pears. Figure 4 shows the schematic description for a simple cistern (4c) with an inflow and outflow. This pictured cistern was used as a hewed subterranean cistern. Besides you can see a subterranean cistern out of clay with inflow (4b) and opening from above (4a). The opening from above is at the ground level and the covering protects against pollution. Figure 5 shows the top view of the cistern-approach at the ground level and figure 6 the direct approach to the subterranean cistern. Often these approaches were built with steps and with depth of 10m under the terrain. The subterranean cisterns from the ancient Greeks were carefully faced with plaster. That’s the reason for the protection of the water against pollution.

Fig.4. Description of a simple cistern (from Tuttahs 1998; changed)

Fig.5. Approach to a subterranean cistern (from Tuttahs 1998)
As already mentioned in December and January rainfall is peaking in Greece. To prevent the destruction of the cisterns, the re-overflow of the water or the flood of the whole terrain people built destitute overflows on the cisterns. Besides that the mixing of fresh rain water and faeces must be also prevented. Figure 7 displays the description of the destitute overflows of a cistern.
2.2 Groundwater-frames/ Pumping wells

2.2.1 Shaft-pumping wells

Shaft-pumping wells are vertical round wells with a diameter up to 1.5m. That wells were faced with hand hewed stones. Through to that the collected water was not polluted with soil or sediment. Maybe the wells had a depth similar to the mightiness of the quaternary sediments. The well-density was ca. one well at a terrain of 500m². Figure 8 show hand hewed semicircular well-restriction-stones.

Fig.8. Well-restriction-stones (from Tuttahs 1998; changed)

2.2.2 Step-wells

Step wells are accessible by stair steps. A small room under the surface is used as spring-basin or draw-basin. The water was collected in the middle of the basin and people transported the water into bowls, jars or with pipes to the surface. These step-wells were 12 m deep, 2 m high and 4 m wide. Figure 9 displays the ground plan and the section for a step-well. With this system water could grained even in very depth aquifers.
2.2.3 Leakage facilities

Leakage facilities are made of collector tunnels with shafts. Groundwater or leakage water stream from above to the lateral leakage pipes. In Milet the people built the most leakage facilities in quaternary sediments. These systems were up to 5m deep. The quaternary sediments represent a very good and productive aquifer. Over the shafts it was possible to transport the water to the surface. Figure 10 shows a schematically description of an ancient leakage facility.

Fig.9. Ground plan and section from a step-well (from Tuttahs 1998; changed)
3. Disposal of sewage/ Sewage systems

In the ancient Greece used water from the households, from public institutions, and also rain water from the streets were collected in sewer systems. In this time people mostly used mixing methods, with them sewage from the households and the institutions were disposed together with the rain water from the streets. Waste water from different sources was collected in open channels in the streets and transported from the town into the surrounding environments. Latrines were installed in all households in the kitchen or in the corridor. Near the house often leakage pits for the depositions of such latrines were common. Latrines for the public life in theatres, thermal and public baths were near the sewage systems, and were transported with other water out of Milet. But these latrines-systems were not built until at 100 years before Christ in the Roman Empire.

Summary: In summary you can say, that in the ancient Greece the water supply was progressive. Every house had its own supply with cisterns or pumping wells. The kind of materials and the technology were reasoned for an optimal water supply. Also the hygienic aspects were decisive for the water supply in the ancient Greece in order to prevent the spreading of sicknesses and epidemics. At the end of the Greek antique the people thought also about the water supply and they built systems to transport the sewage
out of the towns. The faeces were deposed into leakage pits. Only when the Roman Empire began, the people developed systems for deposal of faeces.

4. Literary register

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