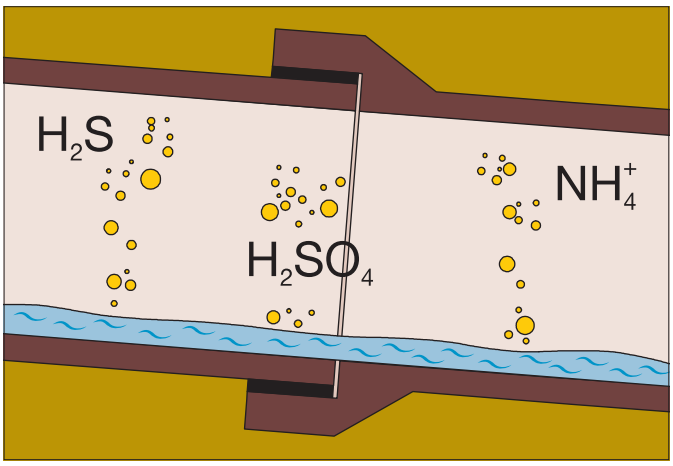
Decision-making criteria for vitrified clay pipes in large nominal sizes



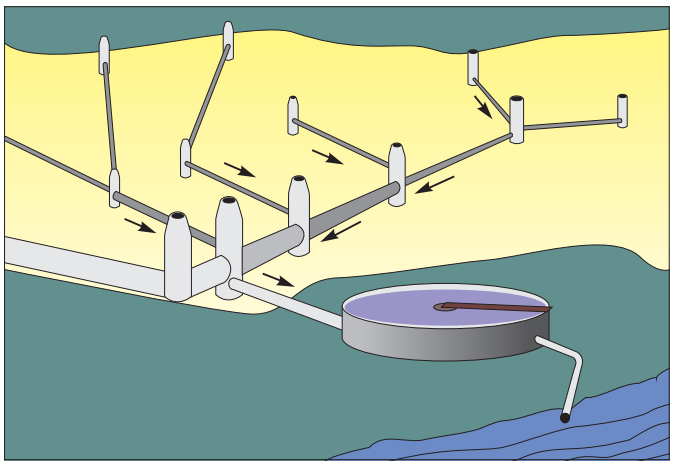
Vitrified clay is environmental protection put into practice. Because, like no other material able to be used for waste-water, vitrified clay produces the proof that it is capable of lasting for generations. The combination of all its optimum properties gives water companies, local authorities, asset managers, planners and developers the certainty of having made the right decision by safeguarding our drinking water, land, waterways and environment.

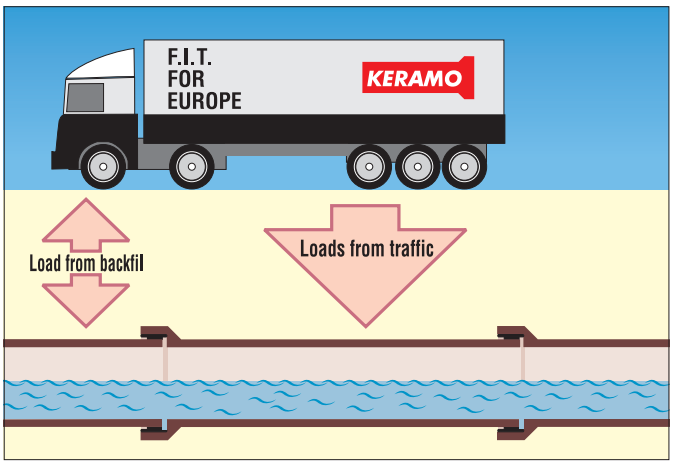
Highly aggressive flows during dry weather

The aggressivity of waste-waters and gases can also be very high in combined system sewers since these only carry rain water for roughly a third of the year. When one considers in addition the situation of the night-flow in dry weather, it is clear that the flow speeds required for self-cleaning are often not reached unless costly counter-measures are taken, e.g.:

- Increasing the gradient resulting in deeper depths of the sewers
- Installation of a number of pumping stations and/or provision of greater conveying heights
- High-pressure cleaning of sewers at regular intervals
- Special sewer design

In municipal areas in which large areas of the surface are sealed and which have combined systems, the cross-section of a sewer able to cope with the amount of waste-water arising in rainy weather will be much larger than if the sewer were to be dimensioned just for dry weather conditions. In many rural and small drainage areas too, low degrees of flow have to be reckoned on. In both cases actual flow speeds will often be below the minimum speeds. As a consequence depositing will take place and this in turn will lead to increases in the aggressivity of the waste-water. For such sewage networks the use of corrosion-resistant materials is essential in both separate and combined sewer systems. Vitrified clay with its high resistance to aggressive substances is the most suitable material.





Longer flow times through central sewage treatment plants

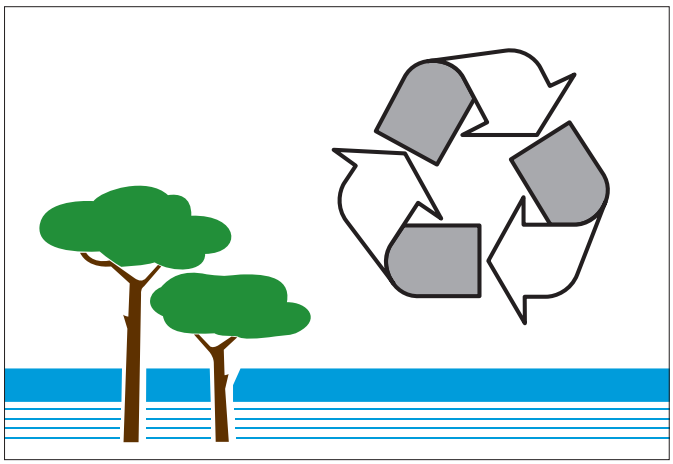
There is a trend towards central treatment plants. In net-work systems with central treatment plants, flow times inevitably increase as does also the degree to which the waste-water in the network putrefies. The reduction in the consumption of drinking water and the tendency to allow rain water to seep away all lead to waste-waters being highly concentrated during dry weather. If a sewage network also has to carry discharges from industrial areas, the risk of high concentrations in the sewers will be even higher however many discharge regulations are valid. When organic materials decompose aggressive acids are released whereby the pH can fall to 0.1 [1]. According to Thistlewayte [2], an average depth of corrosion from 3 to 6 mm per annum for cement-bound materials can be expected when the acid concentration is high (e.g. masonry sewers: joints dissolved; sewer clinker bricks: fully intact).

Not only is vitrified clay resistant to all chemicals but also the sealing systems offer the highest level of security. This is confirmed by, amongst other reports, the latest test results from TÜV Südwest (Technical Monitoring Association, Southwest). According to this report, no function-impairing attack on the sealing material could be established when KERAMO STEINZEUG sealing system “K” was exposed to 68 % sulphuric acid for a period of 1 year.

Ability to withstand high static and dynamic loading

As a result of intensive building activity and increased loads from changes to the infrastructure of underground lines, pipes must be able to withstand static and dynamic loading of a much higher level than previously.

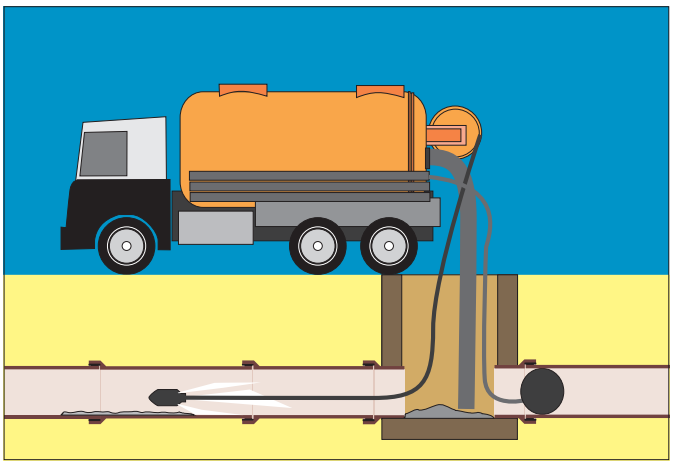
Since vitrified clay pipes are rigid and have a monolithic wall structure (i.e. they do not have a multi-layer sandwich structure), proof of resistance to bulging or deformation does not have to be produced. This holds good in the long-term since the physical properties (in particular modulus of elasticity = 50,000 N / mm²) of a vitrified clay pipe do not change even over periods of several decades. This is an advantage that should not be underestimated in particular when it is intentedto use large nominal sizes. The crushing strength of KERAMO STEINZEUG vitrified clay pipes has been considerably increased in the course of recent years this leading to greater robustness of the pipe system.



Lastingly environmentally friendly

High capital expenditure costs and increasing requirements in terms of the service lives of pipe systems but also too the growing level of environmental consciousness have led to designers, developers and contractors examining critically the materials available to them and taking into account in their decision-making processes the latest findings from science and research.

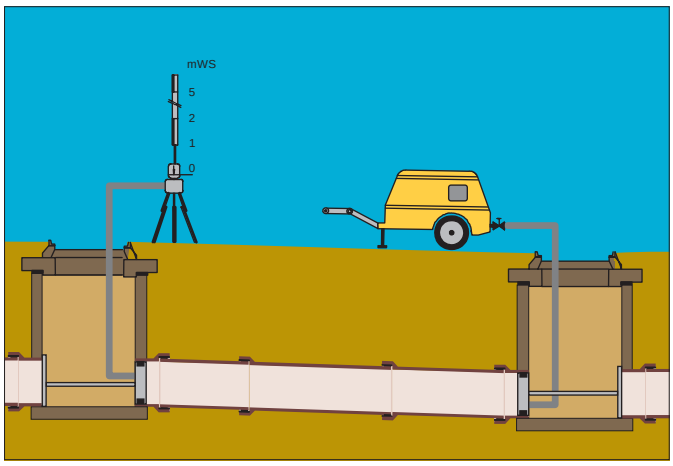
Vitrified clay provides high ecological benefits. Professor Jeschar et al. [3] examined the energy consumed in the manufacturing process and in the provision of all pipe materials as well as the emissions of CO_2, SO_2 and NOx and the waste arising with these materials. In terms of the energy content of large pipes of reinforced concrete, vitrified clay, PVC, HDPE, reinforced concrete with inliner and cast iron, vitrified clay lay in second place after reinforced concrete without corrosion protection. Of these pipe materials vitrified clay has quite clearly the lowest emissions of CO_2, SO_2 and NOx. In addition clay is available as a raw material in almost unlimited quantities while – at the end of its service life - vitrified clay can be converted into high quality products or used again as building rubble.



High resistance to abrasion

When they have steep gradients, sewers are subjected to the erosion-producing effect of solid material in the waste-water such as sand, fine gravel, aggregate spread on roads in winter etc.
When the flow is insufficient, e.g. when there is only a minor gradient, or when the waste-water contains high levels of solid materials, the ATV (Technical Waste Water Association) work sheet A 147 part 1 [4] gives empirically determined cleaning intervals used in practice; these range from twice a year to once every 10 years.

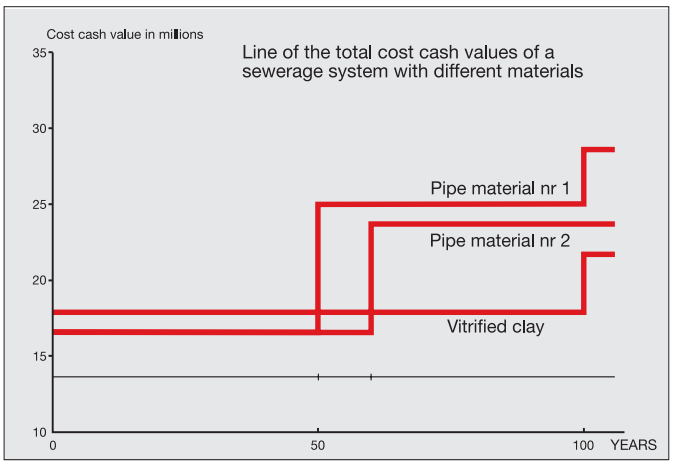
Thanks to their extreme hardness and homogeneous wall structure as well as through their large wall thickness, vitrified clay pipes are very resistant to abrasive substances. Even with very small gradients, glazed vitrified clay pipes offer optimum hydraulic properties thanks to their very smooth surface. As a result the building up of deposits is avoided to a large extent. In addition high-pressure cleaning – should this be required in flat areas – does not lead to any damage to the pipe walls. These findings have also been confirmed by the Zurich civil engineering office. As established there in a series of investigations, vitrified clay provides the highest resistance of all the conventional pipe materials to damage produced by high pressure flushing.



Long-term Integrity

In particular in the case of pipes of large nominal sizes, having a high reserve in terms of tightness under radial loading is an important criteria when selecting the pipe material. Because - as a result of the confined conditions in the trench and the associated greater difficulty in carrying out the compaction of the bedding material, the ability to lay a pipe system easily is of particular importance.
Only pipe systems with integrated and dimensionally stable sealing systems provide the required degree of security.

The vitrified clay standard permits a dimensional tolerance of just 0.5 mm for its sealing elements. With vitrified clay, the ceramic part of the socket represents the ideal abutment against which the seal can be pressed. The shearing path is braked by the vitrified clay socket which is integrally connected to the shaft of the pipe. Creeping, leaks and the entry of roots into the joint are thus permanently prevented. In the proximity of the joint between two DN 800 pipes, a shear load of 25 N/mmDN (2,0 tons) is applied in accordance with the tightness specification of the vitrified clay standard.
In the case of soils subject to settlement, vitrified clay pipes provide high reserves of safety thanks to their relatively short lengths and the ability of the sockets to permit deflection.



Long life and economy

When sewer networks have to be constructed, the decisions made will effect future generations. Not every generation can afford to build its own sewer system. Studies carried out under very different construction conditions have shown that the pipe part of the total project cost amounts to only some 10 % where the laying depth is 3 m [5]. Saving on the pipes through the use of pipes of materials with short service lives is thus misplaced saving. When cost-effectiveness calculations are being carried out, the parameters to be taken into account should include not only purchase price, interest and price increases but also the important factor of service life. If, assuming an investigation horizon of, for example, 100 years, further capital expenditure is required after just 50 years, then this has a catastrophic effect in terms of the evaluation of the fixed assets and waste-water charges.

With vitrified clay, KERAMO STEINZEUG manufactures a material that – like no other used in waste-water applications – is capable of proving its longevity. A large number of CCTV investigations of vitrified clay pipe sewers with ages of over 100 years show that these still appear as good as new – provided that they were laid properly in the first place. Accordingly depreciation rates of < 1 % per annum are possible (for detailed statements see amongst others value R 91 [6]. Materials with shorter service lives lead to displacement of costs through their higher maintenance and operating costs up to the possibility of horrific expenditure in connection with the treatment of drinking water. A variety of recent investigations (e.g. by the Sewer Construction Quality Protection Association) confirm that it pays to construct high quality sewers.

[1] VON R. BIELECKI and H: SCHREMMER: Biogenic sulphuric acid corrosion in partly filled waste-water sewers, page 78 (1987)
[2] THISTLEWAYTE, D.K.B: The control of sulfides in sewerage systems. Beton Verlag (1979)
[3] JESCHAR, R. SPECHT, E., STEINBRÜCK, A.: Influencing of the environment through the manufacturing of waste-water pipes of various materials, Korrespondenz Abwasser. (43) No. Jan. 96, pages 61 – 70
[4] ATV (Technical Waste Water Association) work sheet A 147 – Operating expenditure for sewer systems; part 1: Operating tasks and intervals, issue 5/93
[5] Korrespondenz Abwasser, 7/91
[6] Value R 91 / Treuhand-Fachbeiratsanleitungen, 4th edition, Wolfgang Kleiber, October 1992, Bundesanzeiger