Clay Pipe Development Association Ltd

(TN11) The environmental aspects of clay drainage systems

THE ENVIRONMENTAL ASPECTS OF CLAY DRAINAGE SYSTEMS

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Environmental concerns

As recently as 10 years ago, environmental considerations played only a relatively small part in the specification decisions taken by those involved in the construction industries. Since that time there has been massive growth in our concern for the environment. As land for building becomes less readily available, it has become all too evident that some of the natural resources used are finite and concerns about contamination of land, water and the earth's atmosphere have attracted increasing attention.

The result of this modern concern is an adjustment in the factors which affect purchasing decisions related to construction products. Cost can no longer be the over-riding concern and the long term impact of product choices - in terms of performance and effect on the environment - has become more important than the short term solution.

Critical factors become:

The creation of products which minimise impact on the environment during manufacture.

The conservation of energy during production.

The ability to avoid adverse effect on the environment through performance in use.

Longevity, to avoid the need for premature replacement (and consequent unnecessary use of resources).

Reduced reliance on other finite resources.

Ease of disposal and/or re-cycling.

All of the above are particularly relevant to drainage systems. This is the case because they carry waste which may, itself, be potentially damaging to the surrounding ground and to water passing through it. Also since these pipelines are normally buried within the earth and remain there for many years they are themselves adding to the 'extraneous materials' introduced into the ground.

Today these considerations play a key role in contributing to the resurgence in popularity of proven vitrified clay drainage systems.

Minimising impact on the environment during manufacture

UK clay deposits represent a vast resource and one which, happily, is concentrated in only a few key locations. The quarrying of raw materials inevitably has some sound and visual impact on surroundings. However, significant steps forward have been taken in reducing the environmental impact of this work, for example by limiting the area of excavation open at any one time and through the use of more efficient equipment.

Once work in a particular quarry has been completed it is standard practice to fill it and then landscape the area. Filling the quarry may provide a valuable service, by providing a location for the efficient disposal of waste by local councils and avoiding the need to create sites specially for this purpose.

With filling and landscaping complete, sites are commonly returned to agricultural use, and the re-instated land often offers better performance.

The raw material required in the manufacture of clay pipes has a number of important attributes. With no extensive use outside the construction industry and with very large stocks available in the UK, this is not a resource which can conceivably be exhausted within the foreseeable future.

Pipe materials are entirely natural and no harmful additives are used in their manufacture. (Clay pipes use high technology seals but the overall percentage of such material in any given pipeline is very small.)

The manufacturing process, essentially limited to the vitrification of clay in different types of kiln, produces markedly fewer potentially damaging emissions than a number of the alternative pipe materials. For example, impact in terms of CO_2 emissions and contribution to the greenhouse effect is approximately half that for PVC-u.

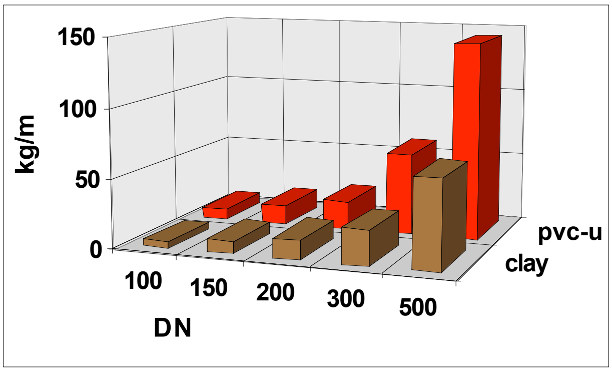

Fig. 1 : Carbon dioxide emission in pipe production

There is growing concern about the effect of manufacturing processes on air quality, acid rain and the deposition of nitrates into the ground, and subsequently ground water. Clay pipe manufacture causes less harm to the environment than the alternatives.
Research findings presented in 1995 to the triennial international conference of FEUGRÉS, the European Federation of Vitrified Clay Pipe Industries provides important evidence. The work, by Professor Jeschar from the Technical University of Clausthal, Professor Specht and Mr Steinbrück of the University of Magdeburg, Germany, shows the values for clay pipe production to be less than

a quarter of those for plastics in respect of human toxicity, acidification and eutrophication.

Fluorine emissions are produced in most operations involving flue gases and, therefore, are a feature of a broad range of industries. All UK clay pipe manufacturers readily conform to current fluorine emission control requirements without the need for additional scrubbing.

Whilst the efficiency of modern clay pipe production in commercial and environmental terms is good, the industry continues constantly to seek refinements that will bring further benefits.

Conservation of energy during production

A key area of environmental assessment for any product will be the use of energy in the manufacturing process. Major strides forward have been taken, particularly in kiln technology, with roller kilns especially making highly efficient use of energy. Further, the heat content of kiln flue gases is re-used in the drying process.

In 1980 comparative energy audits for the commonly used drainage pipe materials showed the energy requirement for a clay pipeline comprising 1,000 metres of 100mm diameter pipe, 250 bends, 60 junctions and polypropylene couplings would total just over 90 megajoules per metre. This represents an estimated saving over the nearest rival (PVC) of some 60 megajoules per metre, whilst cast iron has an estimated energy usage around nine times greater than that of clay.

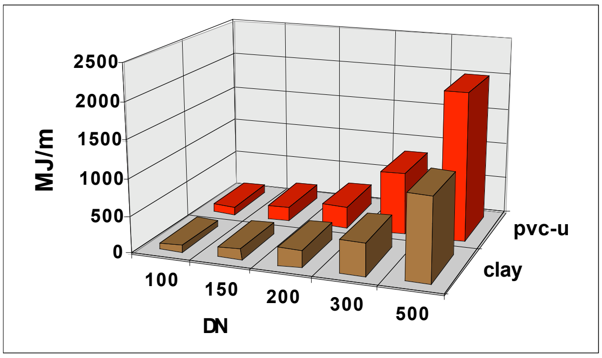

Fig 2 : Consumption of energy per metre of pipe

More recent studies consider not only the obvious energy demand for the production processes and the respective values for the provision of raw materials and auxiliary products but also the effect of winning raw materials, their preparation and conditioning, cleaning and transportation to the producer. Set against this wider review, the relative figures are similar to those highlighted in the 1980s studies, with clay showing the lowest consumption of energy per metre length of pipe across the diameters in which it is most frequently used (DN 100 to DN 500).

Clay pipes have the added benefit that, unlike plastics, they avoid the use of a potential fuel source as a raw material for their production.

Avoiding adverse effect on the environment through performance in use

An appreciation of the attributes of the finished clay pipe gives an insight into the reasons behind its ability to protect the environment in a number of ways.

The inherent strength of clay pipes reduces the risk of accidental damage through handling, disturbance during works subsequent to installation, or as a result of traffic loads.

Pipe impermeability reduces the risk of fluids accidentally leaking into the surrounding soil, whilst the resistance of vitrified clay to chemical attack makes it a safe conduit for virtually all chemicals and a natural choice where particularly aggressive ground conditions are encountered. This is a growing area of importance given the increasing re-use of, for example, former industrial land, which may contain aggressive chemicals such as sulphates, toluene extractable materials, polyaromatic hydrocarbons and ammonia.

The installation characteristics of pipe systems are rarely assessed from an environmental viewpoint but here again clay can offer benefits. The predominance of shorter pipe lengths means that working practices will frequently result in trenches being open for only short periods. Further the industry has worked to develop new systems which can be used in conjunction with trenchless installation techniques, which minimise disruption in many ways and allow normal use of land and facilities in the vicinity of the project.

Longevity and avoiding the need for premature replacement

Clay pipes have been in use for thousands of years and their longevity is well-proven. Most designers work on the basis of a useful life of 100 years or more for clay, compared, for example, with 50 years for PVC. As a result, installing clay pipes represents an excellent investment, characterised by minimum maintenance and replacement requirements.
The length of time over which these products have been proven provides an element of true security, whilst newer materials must, instead, rely on performance extrapolations as a means of predicting behaviour over extended periods.

Minimisation of reliance on other finite resources

The 1990s have seen growing Government pressure on the construction industry to reduce its reliance on aggregates. The Department of the Environment's Minerals Planning Guidance note (MPG6, April 1994) explains: "The Government .....

looks to both the aggregates and construction industries to identify ways of minimising waste and achieving greater efficiency. Local authorities should also examine how they can contribute to greater efficiency of use in construction contracts for which they are responsible."

In the installation of drainage, aggregates are used for bedding pipes. Products with low inherent strength are more reliant upon them. Clay pipes' reduced reliance on aggregates, achievable because of their high strength, cuts installation costs and eases pipeline laying. It helps to avoid the long term problems which can arise with pipes that rely for their strength on an aggregate surround, if that surround is not correctly specified and compacted. Critically, it also reduces pressure on a resource which is becoming less readily available and increasingly expensive.

Ease of disposal and re-cycling

For clay pipes, manufacturing waste products are minimal and such waste as is produced can be directly re-cycled whether in the raw clay state or as the finished product. Broken pipe can be used as 'grog', a percentage of which is required in pipe manufacture or, on site, as hardcore. Importantly clay drainage manufacturing technology centres on the mix of clays used and the development of advanced firing techniques rather than on 'artificial' modification of the original resource. There are, therefore, no substances within the material which can leach out either into water flowing through pipes or from clay fragments within the ground.

Summary

As the environmental performance of products takes on greater importance in specification decisions, what emerges from this brief look at the characteristics of clay drainage systems is that this trend is likely to lead to a further increase in their use.

Measured against a number of key environmental criteria clay pipe systems consistently out-perform their competitors at each stage from raw material, through production and on to installation. Once in situ their strength, chemical resistance and longevity ensure that their environmental contribution will continue for many years.

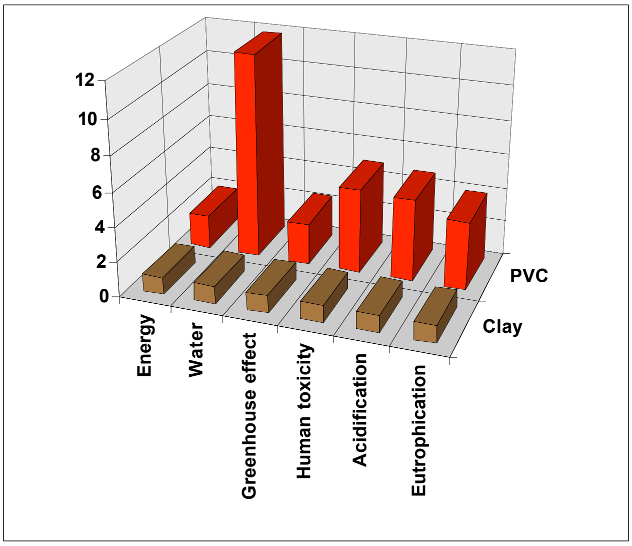

Fig 3 : Effect of pipe manufacture on key environmental factors for DN 300 pipes.

The values shown in Fig. 3 have been calculated from the data in the references below.

References

1. **Energy requirements and eco-balances of materials for drainage and sewerage.** Prof. Dr.-Ing., Dr.Ing.E.h. R. Jeschar, Clausthal Technical University, Claustal-Zellerfield, Prof. Dr. -Ing.habil. E. Specht, Dipl.-Ing. A. Steinbrück, Otto-von-Guericke University, Magdeburg. FEUGRÉS (European Federation for the Vitrified Clay Pipe Industry) Triennial Conference, Nice, 1995.

2. **Cumulative energy consumption of pipes for drains and sewers.** Prof. Dr.-Ing., Dr.Ing.E.h. Rudolf Jeschar, Prof. Dr. -Ing.habil. Eckehard Specht, Dipl.-Ing. Antje Steinbrück. Ziegelindustrie International, April 1995.

3. **Energy consumption and CO_2 emissions during the manufacture and disposal of sewers of different materials.** R. Jeschar, E. Specht, A. Steinbrück. Korrespondenz Abwasser Nr. 4/95.

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TECHNICAL PUBLICATIONS BY THE ASSOCIATION

- The specification, design & construction of drainage & sewerage systems using vitrified clay pipes (2001)
- Bedding construction & flow capacity of vitrified clay pipelines (1995) by C.E.G. Bland
- The problem of hydrogen sulphide in sewers (1992) by Dr. R.D. Pomeroy

All these publications may be obtained **Free of Charge and Postage.**

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