TECHNICAL NOTE

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USE OF PVC SEWER PIPE FOR INDUSTRIAL APPLICATIONS

There are occasional misgivings expressed by users concerning the suitability of PVC sewer pipe for use in industrial applications. The reservations are largely based on possible effects of chemical or high temperature discharges to the sewer system.

This technical note addresses this question and attempts to analyse the element of risk involved, highlight areas where special consideration does need to be given, and recommend appropriate measures where applicable.

Defining the Problem

No material which is acceptable under authority regulations for transmission to their sewers will have any detrimental effect whatsoever on PVC pipe.

The authority regulations are, of course, designed to ensure that the proper biological treatment of the sewage can be achieved, and to protect the entire sewerage system. Pumps, valves, seals and concrete structures are very vulnerable to chemicals, as are rubber rings used in pipe systems.

Industries disposing of chemical waste are required to pre-treat the effluent before discharge to the sewer. Conveyance of effluent before this point is an area where serious consideration should be given to the materials for piping.

Even though PVC can be affected by certain chemicals (see below), it can be solvent welded and may still outperform rubber ring jointed pipe. In certain cases it may be preferable to use butt-welded polyethylene. This choice will depend on the specific chemicals involved.

For mains, after pretreatment of the effluent, the problem resolves itself to one of assessing the risk of damage to a system by either:

- Accidental discharge to the main sewers of a material aggressive to PVC; or
- Deliberate discharge in breach of regulations.

The assessment involves knowledge of the rate of attack of this material, an estimate of the period of contact likely, and knowledge of the resultant effect on the material and serviceability of the pipe.

Finally this risk must be considered in the context of other performance factors associated with the material and compared in total with expected performance of alternatives.

Chemical Effects on PVC

There are various chemical agents that can attack PVC. Consult the Vinidex Water Supply Manual or Chemical Resistance Guide for a comprehensive list. These charts are designed for the purpose of chemical plant usage and the concentration levels referred to are far higher generally than those that would be encountered in industrial sewer mains.

In general, inorganic materials, acids and alkalis have no effect on PVC. The groups of materials that can have an effect are:

a) The highly aromatic hydrocarbons.
b) The heavily chlorinated hydrocarbons.
c) The ketones.

Under a) we have the benzene family and benzene itself of course is present in gasoline. Toluene is another member that could be encountered. Fortunately the most highly aromatic, the more rarely they are used and in smaller quantities. The rate of attack is very slow – for instance it takes months of continuous contact with gasoline to soften PVC. These solvents are all volatile and the chemical leaves the material with no detrimental effects that would compromise the performance of a sewer.

Under b) there are materials such as carbon tetrachloride and methylene dichloride. Methylene dichloride is used in paintbrush cleaners and is in fact used in testing of PVC for gelation levels. In this test surface attack is registered after 20 minutes in a poorly gelled material, and perhaps hours if well gelled. Again, to affect the body of the material, long periods of continuous contact are required, and the solvents evaporate on removal of the source to leave no damage of any consequence.

Item c) is a group of materials that can have widely varying effects. It includes acetone, used also for testing PVC, producing surface attack after 2 hours to several days. Also methyl ethyl ketone, used as a primer for PVC and as a constituent of PVC solvent cements. The same comments apply regarding volatility as for group b) and c).

In all of these cases, the likelihood of damage being incurred to a sewer main through discharge of the materials is very small. Whilst they are termed solvents, the name is misleading, since in many cases the effect is simply swelling of the PVC, and in others the rate of attack is so slow that it would not constitute solubility in the normal sense of the word.

The more aggressive the material, in general the more volatile and more expensive it is, and therefore the less it is used and the less likely to be disposed of, either accidentally or deliberately, by way of the sewers, in sufficient quantity to do damage.

There are of course some chemicals outside of these groups that can have an effect on PVC. They are not in common usage in general but one worth mentioning is creosote. Prolonged contact with creosote will soften PVC, and this could feasibly occur where ground around telephone poles is heavily treated in the vicinity of a PVC pipe. It is more a problem for water pipes than sewers because they are laid at shallower depths.

Temperature Effects on PVC

Hot discharges can be a potential hazard to PVC pipe, but the pipe work system is only likely to be affected close to the discharge point, if at all.

The effect of temperature on PVC is well documented and the response of the pipe predictable.

The recommended maximum continuous operational temperature for PVC pipes is 60 °C. This limitation refers to the complete pipe wall being at 60 °C and would apply for constant discharge at 60 °C.

For discontinuous flow, discharge temperatures can exceed 60 ° C. The actual maximum temperature depends on several factors such as the volume and duration of the discharge. This should be assessed for a specific application in terms of the 60 °C limitation on pipe wall temperature. [1]

For above ground piping, consideration should be given to the support spacing. Consult AS2032 for installation recommendations, including provision of support. For a discussion on the deflection of suspended pipelines, see Vinidex Technical Note TN-12C.

In an established line where backfill consolidation is complete, the actual load carrying requirements of the pipe are very small, since the surrounding soil is doing most of the job. This is shown in calculations of predicted long-term deflection performed in accordance with Australian Standard AS/NZS 2566.1. A DN150, SN 4 DWV pipe, installed at 3m depth in various embedment materials, shows minimal increase in predicted deflection as the pipe wall temperature is raised from 20°C to 60°C. Some typical calculations are given below.

Temperature	Predicted Deflection %		
	E'n=3	E'n=3	E'n=3
°C	E'e=5	E'e=3	E'e=1
20	1.7	2.7	6.1
30	1.8	2.8	6.5
40	1.8	2.9	6.7
50	1.8	2.9	6.9
60	1.8	2.9	6.9

[1] Elevated temperature cycling tests for PVC pipe use water at 88°C to 95°C (34L/90s) alternating with water at 10°C to 15°C (34L/ 90s).

To reach a condition that might be considered dangerous, the whole pipe wall would have to exceed 60°C, installed with no compaction in wet clay. This would require prolonged discharge of large volumes of very hot liquid.

It is almost inconceivable that mains piping would be subjected to such treatment other than by a full-scale catastrophe. If piping close to the discharge point may be required to carry such flows, special consideration should be given to materials for this section.

Note that an underground pipe is actually safer than pipework above ground at extremes of temperature, since the soil provides support. Where necessary above ground pipework and, in extreme cases, the first few lengths of underground pipe should be provided with additional support, or alternative materials considered.

Summary

The risk of damage to sewers through chemicals or high temperatures diminishes with size for a variety of reasons.

The dilution factor. Larger sizes carry more users, so aggressive effluents are progressively diluted and more consistently flushed, and the probability of damage from a large discharge decreases.

Wall thickness. Larger pipes have thicker walls, so any effect is relatively smaller.

Volatile components disappear early in the system before the discharge reaches the larger diameter pipe.

Temperature declines rapidly with passage of effluent through the sewer.

Clearly the only area where any real risk lies is upstream of pretreatment plant close to the discharge point. The combined probability of an accidental or deliberate illegal discharge occurring:

- bypassing pretreatment,
- being of sufficient chemical aggressiveness or sufficiently high temperature,
- being of large enough quantity, and
- for a sufficient period of time to materially affect a PVC sewer, is so remote as to be negligible.

The performance of PVC sewers in practice bears out this contention. In world experience of four decades no failure of mains PVC pipe due to those causes has been brought to the attention of Vinidex, and indeed even in the property services area, such instances as exist are due to very exceptional circumstances.

For further information about our products and applications, see our web site at

http://www.vinidex.com.au/

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