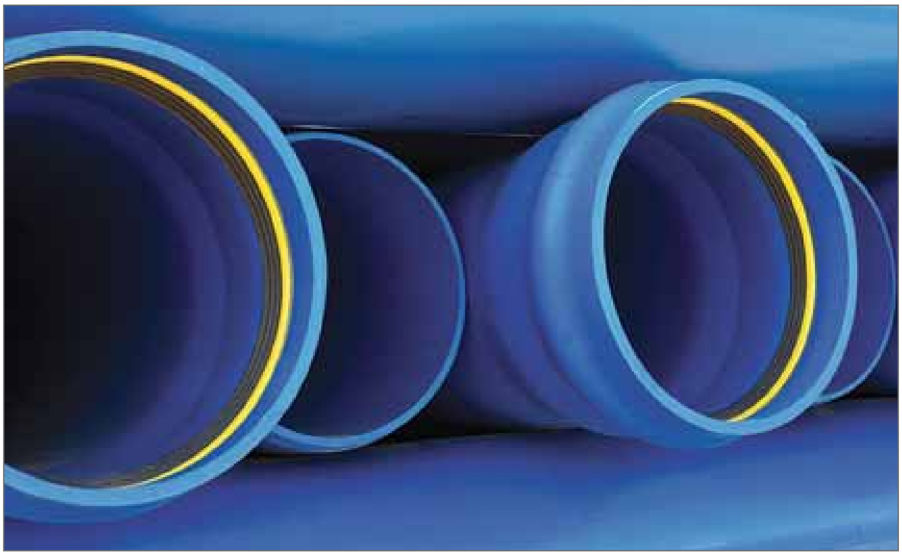
Pipe alerts from SAPPMA

REPLACEMENT OF WATER PIPES IN MAJOR MUNICIPALITIES IS LONG OVERDUE



The South African Plastic Pipe Manufacturers Association (SAPPMA) warns that the replacement of old water pipes around the country is long overdue. According to Jan Venter, SAPPMA chairman, the existing steel and asbestos cement pipe infrastructure in South Africa has undoubtedly corroded during the last 50 years.

"Water distribution, waste disposal, irrigation and telecommunication all rely on pipelines to function. Pipelines, therefore, lie at the heart of South Africa's infrastructure and should be replaced before they fail," Venter warns.

Referring to the 2011 Census results, which show that South Africa's population has increased from an estimated 40.5 million people in 1996 to an estimated 51.8 million in 2011, Venter warns that the country's infrastructure is under pressure and could collapse if municipalities do not follow the example of the eThekwini municipality in Durban, who recently completed a $US205 million Asbestos Cement (AC) Pipe Replacement Project, replacing 1 750 km of ageing asbestos cement water pipe with modified polyvinyl chloride (mPVC) and high-density polyethylene (HDPE) pipe.

"Most of the old pipes were installed in the early 1960s and have undoubtedly reached the end of their effective life span. Unless urgent attention is given to the replacement and maintenance of the water infrastructure, the end result is predictable – bursts will start occurring on a daily basis, followed by catastrophic component failure and regular and prolonged disruptions in service delivery."

Venter warns further that both the quality and quantity of water are under severe pressure in South Africa, aggravated by rapidly increasing demand, severe pollution and huge losses in distribution. "Two major causes of water loss are corrosion and poor jointing. For this reason, old steel or asbestos pipes are being replaced around the country with plastic pipes, because they do not corrode and the joints are leak-proof if done correctly."

"Although the plastic pipe industry is relatively small, it is of extreme importance in the development and maintenance of the country's infrastructure," Venter says. "It is also one of the most demanding industries, as our products are required to last in excess of a hundred years." HDPE and PVC pipes answer these calls with distinction as the materials are lightweight and easy to handle, easy to join, available in a range of sizes and pressure ratings and have low frictional resistance, with hydraulic properties that remain virtually unchanged over its useful life, which results in low pumping costs.

Venter says that not many people spare a thought for the thousands of kilometres of plastic pipes that supply rural communities across Africa with clean drinking water. "However, water is fast becoming a critical problem, and we urge local governments to pay attention to the warning signs by implementing a pipe-replacement project and investing in developing the necessary technical skills required for such a project."

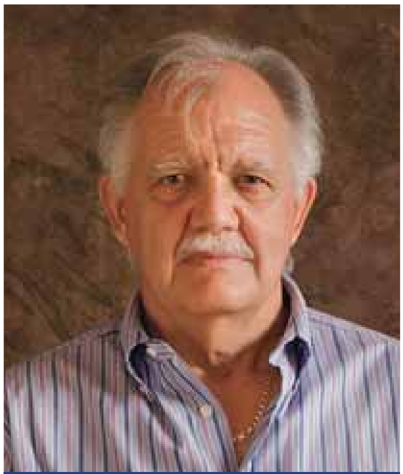
INVESTIGATION INTO THE ENVIRONMENTAL IMPACT AND ENERGY COSTS OF PLASTIC PIPE

SAPPMA recently released the findings of a study which aimed to investigate the environmental footprint caused by the manufacturing and use of plastic pipes.

Venter explains: "The dramatic increase in the world's population, industrialisation and urbanisation, is making people realise that present energy sources are limited and are bound to run out unless they are better preserved. It is also leading to renewed effort to develop alternative energy sources on an economic and commercial scale. Energy is subject to the law of conservation of energy, which states that energy can only be transferred or transformed from one form to another – it cannot be created or destroyed. All of this has led to an increased awareness of the energy needed to produce, operate and maintain systems. Piping systems are costly elements in infrastructure and it is therefore correct to also evaluate the associated energy costs."

Embedded/embodied energy of plastic pipe

In order to quantify and correctly assess the amount of energy that is used to manufacture a material or product, an embodied energy analysis is performed.



Jan Venter, chairman of SAPPMA

Table 1 Embodied energy coefficients for pipe types (GJ)

Pipe Material	Embodied Energy GJ
DICL	1 100
PVC-U PN 12	312
PE 100 PN 12.5	312
PVC-M S1 PN 12	225
PVC-O S1	200

Table 2 Energy requirement in the manufacturing of 1 km of 110 mm pipe (MT oil equivalent)

CI	GI	RCC	PVC
19.7	10.0	6.0	3.5

NOTE: CI = Cast Iron; GI = Galvanised Iron; RCC = Reinforced Cement Concrete; PVC = Polyvinylchloride

Table 3 Results obtained from a study done in Europe

	PVC	PEHD	PP	PET	Clay	DI
Material energy MJ/kg	56	76	73	83	10	25
Pipe weight kg/m	5.7	5.4	4.4	5.8	33	40
Energy MJ/m	319	410	318	481	330	1 000
Oil consumption kg	6.9	8.9	6.9	10.5	7.2	21.7
CO_2 emitted kg	20.8	26.8	20.7	31.4	21.5	65.2

Table 4 Approximate mass in kg/m of 600 mm diameter pipe

HDPE	RCC	Steel
31	297	141

This involves assessing the overall amount of energy that is needed to extract the raw material, manufacture the product and maintain it.

The basic factors that influence the embodied energy of a piping system are:

- Pipe size (quantity of material used)
- Type of material used
- Durability and design life of the system
- The amount of energy required to pump the fluid
- Amount of maintenance required during its lifespan
- The use of recycled material
- Whether the material can be recycled after its useful life.

Studies using 1 000 metres of 100 mm nominal size pipes were conducted in Australia, arriving at comparative sizing based on a flow rate of 10.4 ℓ/s and a head loss of 7.84 m with results as shown in Tables 1 and 2. Results obtained in another study done in Europe are shown in Table 3.

Even though the material energy of ductile iron is a lot less than that of plastics in terms of mass (MJ/kg), the picture reverses when the wall thickness and mass per metre are taken into consideration (MJ/m). Similarly, the amount of carbon dioxide that is emitted by the production of plastic pipe is far below that of ductile iron.

Transportation

Thanks to the low mass of plastic pipe (see Table 4 for comparison) the study has shown that the cost of transporting plastic pipe is considerably less than that for the equivalent pipes in steel or concrete.

Pumping cost

"It is vitally important to consider the amount of electricity used in the pumping of fluids through pipelines," Venter says, adding that it is estimated that 60% of the world's electricity is used by electric motors and that 20% of this is used for pumping. "Because of the specific properties of plastic pipe, the walls offer very limited resistance to flow (low friction), and even more importantly, remain virtually unchanged throughout its design life."

Comparative calculations show that the increase in power or pumping costs after 50 years is only 13.6% for thermoplastics compared to the massive 62.6% for steel. The situation gets much worse beyond 50 years, as can be seen from Table 5.

Recovery and recycling

Plastic pipe can be recycled easily and is indeed being recycled on a relatively large scale because of the high value of polymer used in the manufacturing process. Although it is difficult to find old, unused pipe simply lying around anywhere which can be collected for recycling, a recent survey has shown that approximately 14 000 tons of HDPE and PVC pipe were recycled at external facilities. In-house recycling by pipe manufacturers is estimated to be in the region of 8 000 tons, bringing the total for these two pipe materials to about 22 000 tons per annum.

"Plastic pipe is not wasted and therefore does not contribute to environmental pollution. Hundred percent of recycled pipe can be re-used, but strict quality requirements set by SAPPMA allow most of it to be used only in non-critical applications," Venter says. Although ductile iron and steel pipes can also be recycled, the energy cost to do so makes the process considerably more expensive than for plastics. Basic calculations show that the power consumption to recycle plastic pipe is approximately R0.09/kg compared to R0.23–R0.45 for steel, bearing in mind that many steel pipelines are internally lined with material that first needs to be stripped from the steel.

CONCLUSION

The results of the local tests support the findings of the European Denkstatt Study, which analysed the environmental impact of 173 products throughout their entire life cycle in a study entitled *Plastics' Contribution to Climate Protection* and which was funded by the European plastics industry. This study identified plastics' share of citizens' carbon footprint and provided a carbon lifecycle analysis of plastics compared to their alternatives in packaging, transportation, building and construction, and eco-product enablement (e.g. solar panels, wind turbines, etc).

Initial results revealed that, while the carbon footprint of an average European consumer amounted to approximately 14 tons of CO_2 per capita, a mere 1.3% (170 kg) stemmed from the use of plastic products. The preview data released during this event unveils that plastic saves 2 300 million GJ in energy every year. This equates to 50 million tons of crude oil – the size of 194 very large oil tankers. They also prevent GHG emissions of 120 million tons per year.

References

Members of the SAPPMA Technical Committee compiled the research findings from the following sources of published results from Europe and Australia, as well as from own calculations and research:

1. Piping Systems Embodied Energy Analysis, by M D Ambrose, G D Salomonsson and S Burn of CSIRO
2. Plastics Recycling Survey 2009 – Plastics Federation of SA
3. The European Association of Plastics Manufacturers
4. Ahmedabad Municipal Corporation
5. Sasol Polymers

Table 5 Comparison of power costs

Years	0	10	20	30	40	50	% increase	100	% increase
Thermo-plastics	33.446	34.288	35.163	36.073	37.019	38.004	13.6	43.352	29.6
DI	38.004	40.100	42.380	44.865	47.581	50.560	33.0	67.008	76.3
Steel	43.595	47.581	52.159	57.451	63.618	70.867	62.6	114.059	161.6

Source:
http://www.saice.org.za/downloads/monthly_publications/2013/2013-Civil-Engineering-June/#/0