Comparative results in the reduction of Non-revenue Water Consumption Using Various Technology Solutions

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Background

The data presented in this paper was generated as a result of a project undertaken in Tshwane beginning in June 2004 and which in some instances is still active today.

The purpose of this project was to evaluate the efficacy of a cross-section of technology solutions in an effort to reduce non-revenue water losses.

After site visits to existing projects utilising the various technologies available, six different products each from an independent manufacturer were selected for the project. In instances where restriction was achieved by flow rate restriction, the minimum flow rate deemed acceptable was 1 litre/minute, with anything less deemed to be unacceptable to consumers.

The selected devices were tested under real-life conditions on consumers that were already subjected to restrictions due to delinquency and non-payment.

48.5% of all households in the ODI area which were already subjected to restrictions consumed in excess 40 Kilolitres per month. This high consumption is attributed to tampering with the restriction devices, illegal reconnections and especially to restricted flow rate consumers leaving taps running.

Chosen Devices

The following six devices were selected:-

- Manual Flow Rate restrictors
    1. Valve Stem Lockers
    2. Locker
    3. 3 way Valve (Disregarded as service level too low)
    4. Intelligent orifice
    5. Flow Rate Control Valve
- Electronic Dispenser
    6. Flow Limiter / Water Dispenser

Methodology

Manual Flow Rate Restrictors essentially throttle the rate at which water is able to flow through the consumers tap. These flow restrictors are commonly designed or set to dispense 1 litre per minute, thus supposedly reducing the quantity of water consumed or wasted. As an unrestricted consumer, one would typically expect a flow rate of 20 to 50 litres per minutes depending on connection size and system pressure.

Electronic Limiters or dispensers use the pulse output feature of modern water meters to calculate and record quantity of water used. As they are electronically controlled, these devices can be configured to dispense any required quantity of water in a 24 hour period. In the Tshwane example, the devices were programmed to dispense 400 litres per day.

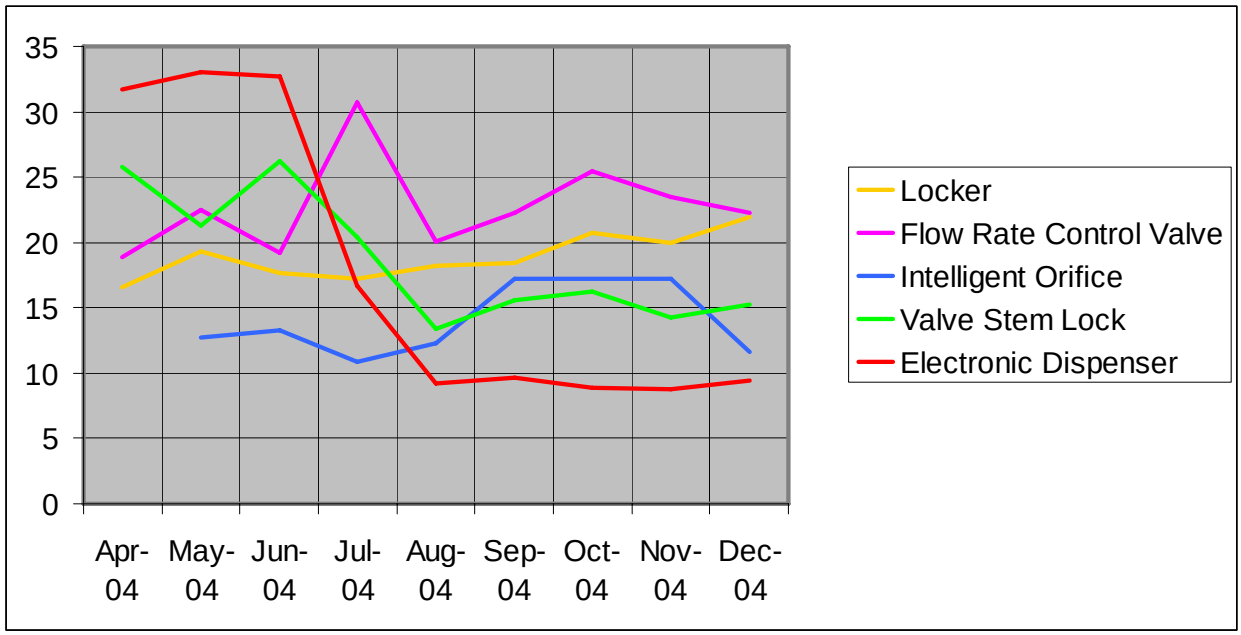
The principal difference between these categories of devices is that the manual restrictor throttles the rate of flow of water, whereas the electronic device dispenses water at full flow rate. This ensures a much higher level of service to the consumer, while far more accurately dispensing a finite quantity of water.

Results

The following table and graphs illustrated the effect of on average water consumption when using the various devices:-

Average Monthly Household consumption in Kilolitres

	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Locker	16.59	19.26	17.62	17.21	18.19	18.43	20.75	20.01	21.9
Flow Rate Control Valve	18.91	22.45	19.21	30.72	20.1	22.31	25.43	23.52	22.28
Intelligent Orifice		12.73	13.3	10.86	12.3	17.18	17.18	17.25	11.59
Valve Stem Lock	25.74	21.28	26.27	20.39	13.4	15.53	16.23	14.27	15.26
Electronic Dispenser	31.68	32.99	32.67	16.67	9.25	9.67	8.93	8.77	9.48



Deductions

The device that performed best overall is clearly the Electronic Water Dispenser reducing water consumed by almost 75%.

The surprising aspect of this result is that despite reducing the consumption to the lowest level out of all devices used, very few households have applied for the removal of the device once their arrears are repaid.

Also noteworthy is that despite being configured to allow 400 litres per day or 12 Kilolitres per month, average consumption per household using this device is 300 litres per day or 9 Kilolitres per month. The only possible explanation for this phenomenon combined with overall high level of satisfaction is that households tighten up considerably on wasted water to ensure supply lasts throughout the day.

Observations

Costs - The price of manual restrictors can be considerably cheaper to acquire and install, but may not be as effective at reducing water consumption.

Efficacy - Installation of technical or technology solutions does not always remedy the situation, with some interventions or devices actually increasing the consumption of average water consumption. This can at least partially be attributed to the fact that standard consumption calculations when using Flow Restrictors assumes 8 hours of use per day, whereas this is generally a gross underestimation of actual use.

An example of this is often referred to as the "Madideni Washing Machine" – where consumers that are subjected to restricted flow rate simply connect a hose to their taps and leave the water running permanently or semi-permanently into a drum. They will place their washing in the drum prior to going to work with some washing powder and return to clean clothes and a drum full of fresh water ……. and hundreds of litres of wasted water running down the road or into vegetable patches.

Social Aspect – The importance of community cooperation in implementing any sort of intervention cannot be underestimated and must combine a holistic approach including:-

- Consultation and education of communities
- Regular monitoring and inspection
- Strict application of punitive measures for vandalism and bypassing

Correct and advance handling of these issues is likely to go a long way to reduce instances of resistance to the project and delinquency after installation.

Ring fencing is paramount to achieve the best results out of any intervention, allowing monitoring of the project's efficacy using 'before and after' bulk meter readings.

Conclusion

A distinction should be drawn between punitive restriction and cooperative restriction.

Punitive restriction is aimed at consumers who can afford to pay for water consumed regardless of level of consumption. In other words, consumers who willingly use or waste water but refuse to pay despite having the means to do so.

Cooperative restrictions are a constructive and voluntary agreement between a service provider / municipality and consumers who genuinely cannot afford to pay for water regardless of how little it may cost. A classic example of this category of consumers is indigent household or those referred to as "the poorest of the poor". In this case, punitive restrictions are going to result in payment of arrears as these households simply do not have the money to pay for their water usage.

The only sure answer to effect reductions in these households is through education and cooperative restriction which ensures that households are unable to enter into a position of indebtedness.

In the case of punitive restriction, it is important to inconvenience the consumer to the point that they will make payment for services. Using a Flow Rate restrictor will achieve this end quite efficiently.

In the case of indigent households, the most important aspect of water service delivery is not inconvenience, but to ensure that they are unable to overuse water. Failing this, consumers get caught in the "Debt Trap" cycle where exceeds affordability for several months before action is taken and insurmountable debt is already incurred by the time remedial action is taken. The ONLY method to prevent this scenario is to use a Water Dispenser which accurately provides daily allotment of water which is negotiated with households as part of the Municipality's Free Basic Water policy.

It may seem ironic that the poorest segment of the community requires the highest level of technology to service their needs, but it is important to provide the highest level of service possible to ensure their cooperation and acceptance of the chosen solution.

The key objective should remain the reduction in non-revenue water in instances where it is wasted or where it is possible and humane to collect revenue for it.

In the instances where devices proved effective in reducing water demand, it is possible to achieve capital redemption within a single year of implementation regardless of the initial capital cost of acquisition of the devices.