THE USE OF SUBMERSIBLE PUMPS TO IMPROVE EDUCTIONS FROM SEWER PUMPING STATIONS

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ABSTRACT

Staff from the sewer operations group often has to educt from sewer pumping stations to enable pipe relining/rehabilitation or emergency repair works to be undertaken on sewer rising mains.

It was identified that the eduction process could be sped up and made quieter to be more efficient and less disruptive. Field staff designed and built a portable electric powered submersible pump with a capacity to deliver 60 litres per second. This was operated with a three phase power switchboard, connected to either the sewer pumping station or a portable generator. A "y" junction was developed to deliver flows more quickly into two trucks at once. The submersible pump has reduced tanker spill times by 60 – 70%, and halved the number of tankers required, thus saving almost 50% of cost for the utility.

In addition, site noise has been significantly reduced through the use of an electric pump and avoiding the need for tankers to run their engine continuously whilst using their onboard vacuum pump. This influences greatly on the environment with less pollution due to emissions and lower noise level to keep the public happy. As we now avoid the presence of several tankers to be around the site, OHS issues become a lesser risk. Traffic Management is further optimised and the lower potential for failure provides overall satisfaction and less stress on field crews.

The next step is to further trim the dimensions of the submersible pump so that it can fit in a standard 600 mm diameter sewer manhole.

In comparison to previous, similar sized jobs, the estimated benefits are as follows:

- overall saving of 50%
- reduced risk (assessment) to resources employed
- less complaints from residents (noise and emissions)
- lower environmental impact
- faster eduction of flows
- quicker completion of jobs
- reduction of manpower in attendance

A typical case scenario/study is attached.

1.0 INTRODUCTION

'us' - Utility Services is a strategic alliance between three innovative and service oriented companies – ***South East Water, Thiess Services and Siemens.***

The alliance provides a broad range of utility, construction and maintenance services, including maintenance and operation of South East Water's sewerage system. This includes over 230 sewage pumping stations, and more than 7,800 kilometres of reticulation sewers.

In 2005, **'us'** – Utility Services began progressively relining the older sewer rising mains with a structural liner. These works required the rising mains to be emptied and flows to be educted from the sewer pumping stations.

These rising mains and pumping stations frequently have high flows and are often located in densely populated residential areas. Often, the works are done continually for up to five days. From time to time South East Water has experienced failures on its sewer rising mains which have required shutdown of the sewer pumping stations.

These emergency situations require eduction to keep up with the incoming flows. Eduction may be required over long periods of time, and for larger sewer mains can require many eductor trucks.

Conventionally, the eduction works are done with eductor trucks, using their own vacuum pumps and hoses.

However, there are several areas for improvement with this practice:

- Eductor trucks need to keep their engines running while using their vacuum pumps, which means they are noisy and consume large amounts of fuel. This can result in complaints from nearby residents, especially during all night jobs.
- High flow pumping stations need large numbers of eductor trucks to keep up with the flows. Some of South East Water's pumping stations require at least 10 eductors, which adds to the cost of the job and increases the complications on traffic management.

Due to their roles and experience, Ian Syer and Warren Roberts are regularly involved with managing the eductions from sewer pumping stations. They decided to try to improve the management of situations as described above, and came up with the aim of:

Removing sewage quicker and quieter than eductor trucks alone.

2.0 DISCUSSION

2.1 Selection of a Pump

It was suggested that a portable electric powered submersible pump would provide a solution to most of the areas for improvement. These pumps are designed to be used with sewage, and can handle being submerged for long periods. They can pump up to approximately 60 litres per second.

2.2 Portability of the Pump

The pump and switchboard were mounted on a single pallet. This could be picked up easily by a forklift, and put onto the tray of a utility or small truck. In addition, pipe lengths could also be fitted onto the same truck. At the work site the pallet would be lifted off by a small crane truck.

Figure 1: ***Submersible pump, switchboard and hoses loaded on a small truck.***

2.3 Additional Features

A switchboard was designed and built to go with the pump. This enabled the pump to be operated with three phase power, commonly available at most of South East Water's sewer pumping stations. It also meant that the pump could be run by generators if electricity was not available.

Another feature that was added to the pump was float switch controls. This enabled the pump to be set and left for long periods, rather than have to manually switch it on and off. The pre-set flow levels in the pump well would regulate when the pump was activated.

2.4 Filling Multiple Tankers

Given the flow rate of the pump, it was felt there would be opportunity to develop a split discharge hose so that two tankers could be filled at once. Initially this was tried with a standard "tee" junction to split the flows. Unfortunately, this configuration delivered well below the theoretical flow rates to both lines, and it is believed that resistance of the 90° bends was a significant factor. To reduce this resistance a "y" shaped junction was developed with bends of approximately 120°. This resulted in flow factors much closer to the theoretical figures.

Figure 2: ***Fittings for submersible pump, including "y" junction.***

2.5 Trialling Submersible Pumps

The submersible pump has been trialled in the field on numerous occasions, and for prolonged periods. It has been utilised at programmed pumping station shutdowns, as originally envisaged, but also for emergency eductions during a major burst on a sewer rising main. It has been run off the three phase power directly from a pumping station, and also from a diesel powered generator. The "y" junction has been utilised for filling multiple tankers.

Figure 3: ***Unloading submersible pump with small crane truck.***

2.6 Case Study – Eastbourne Road Sewer Pumping Station

On 31 May 2006, South East Water suffered a burst on the Sixth Avenue Sewer Rising Main, necessitating major repairs by ***'us'*** – Utility Services. To facilitate these repairs, all incoming pump stations were switched off, including Eastbourne Road Sewer Pumping Station.

Eastbourne Road Sewer Pumping Station needed to be educted to keep up with the incoming flows. Two tankers can access the site at once, but due to space restrictions only 10,000 litre tankers can be used. Using the eductor trucks' own vacuum pumps, it typically takes between 20 to 30 minutes to fill two tankers. Normally, we would require five tankers plus an additional one at peak flow times to manage the incoming flows.

On this latest occasion, it was decided to use the submersible pump linked to the pump station's three phase power. Once installed, the submersible pump could fill two 10,000 litre tankers in 8 minutes. Therefore, 60,000 litres were being removed in the same time it took the old vacuum pump system to remove 20,000 litres. This was done using only three tankers – rather than the normal five – plus an additional one at peak flow times. This represents a 40% saving on the normal costs for educting this pump station.

The increased flow rate was particularly important with these works because the rising main took over 20 hours to repair. It is highly unlikely that the normal vacuum pump process would have been able to keep up with the incoming flows sufficiently to prevent an overflow from the pump station. However, the submersible pump system ensured there were no overflows throughout the exercise.

Finally, even though the eduction process worked throughout the night – and Eastbourne Road Pump Station is close to residential houses – there were no noise complaints. We believe this was due to the use of the electric powered submersible pump.

3.0 CONCLUSIONS

3.1 Outcomes of Trials

The trials with the submersible pumps have been consistently successful. In all cases the pump was able to fill tankers in **30-40%** of the time that it would take a standard vacuum pump. This improved our ability to keep up with incoming flows, and in some cases reduced our need for tankers by as much as **50%.**

The submersible pump was driven by its own power source – mains electricity or generator – so the eductor trucks could switch off their engines while being filled. This **reduced fuel** costs to the eductor companies. Moreover, it reduced the amount of noise generated by the works, such that there was a noticeable reduction in impact on adjoining residents. This was the same pattern for both the mains electricity version, and the generator-driven version, which was extensively sound-proofed.

An unexpected benefit of the use of the submersible pump was that it enabled us to use tankers with no vacuum pumps. This was particularly important during an emergency burst rising main incident, when as much tanker capacity as possible was required. It is worth noting that some eductor companies now have large capacity trucks (20,000 to 30,000 litres) without any vacuum pumps.

During the trials the only failure of the submersible pump was a split in the suction hose line. The pump was lifted out and the length of hose replaced in less than an hour.

One of the manholes where the pump was being utilised required modification to enable the pump to be lowered in. This required the neck of the manhole to be cut and lifted off. This exercise took less than half a day, and the manhole was replaced after the works were completed. A bituminised seal was used so that the manhole neck could be removed in future if required.

3.2 Where to From Here?

To further increase the usability of the submersible pump, we are looking into further trimming it so that it can fit into a standard 600 mm diameter manhole.

4.0 SUPPORT INFORMATION

Introductory video about the system in operation.
Poster presentation.

5.0 ACKNOWLEDGEMENTS

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