Improved Power Delivery and Portability for Sewage Sampling Equipment

for Kishwaukee Water Reclamation District

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***Abstract*— Sewage samping has become a vital component to monitoring public health, due to the COVID-19 pandemic. By testing samples of sewage for traces of COVID-19, health officials can predict a spike in cases weeks in advance. Kishwaukee Water Reclamation District requires the ability to quickly and efficiently deploy sampling equipment within the DeKalb community, as this can have a major impact on how local health authorities respond to health crises. This project aims to simplify the deployment process of existing sampling equipment through an improved mounting system and a more efficient power delivery system. Composite flow-paced sampling deployment is improved by a corrosion-resistant 316 stainless steel mounting system. This combines the flow meter, sampler, and power delivery system into a single unit. Efficiency is improved through a unified power delivery system created around a Milwaukee M18 Lithium-Ion battery pack. This has allowed the flow meter and sampler to run off a single M18 battery pack with more than double the original runtime and reduced weight.**

I. Introduction

Recent studies have indicated that COVID-19 is detectable in human waste early in the virus's incubation period, regardless of whether the person is symptomatic. As a result of these studies, sanitary sewage has begun to be tested around the country as an indicator of the presence of COVID-19 in a community.

Kishwaukee Water Reclamation District (KWRD) is the sanitary sewer and wastewater treatment utility for the City of DeKalb and Northern Illinois University. KWRD requires the ability to quickly and efficiently deploy a portable area-velocity flow meter (2150 Area Velocity Flow Meter [1]) and composite sampler (GLS Composite Sampler [2]) while simultaneously improving the efficiency of the power source for both devices.

There are many different methods to implement composite sewage sampling using portable sampling equipment. Because of the large variance in flow volume within the sewage system, flow-paced composite sampling is necessary to provide the most representative sample for testing the presence of COVID-19 and other viruses.

Flow-paced composite sampling involves setting a specific sample volume to be collected and a specific volume of flow that must pass through the section of pipe before a sampling event is triggered. e.g. one 15mL sample triggered every 3,785 Liters (1,000 Gallons) of flow for 24 hours.

Flow-paced sampling consists of a flow meter device capable of measuring the volume of flow passing through a section of pipe in addition to the portable sampler device. The sampler would use flow volume data from the flow meter and a sampling event would be triggered once the volume of flow reaches the programmed value.

II. Methods and Materials

A. Mounting System

The mounting system is designed to keep all equipment secured in place, while remaining portable and allowing for easy access to the contained equipment.

The material used to construct the mounting system is 316 stainless steel. This material was chosen due to matching the material used on the portable sampler and due to the addition of molybdenum, which gives it excellent corrosion resistance.

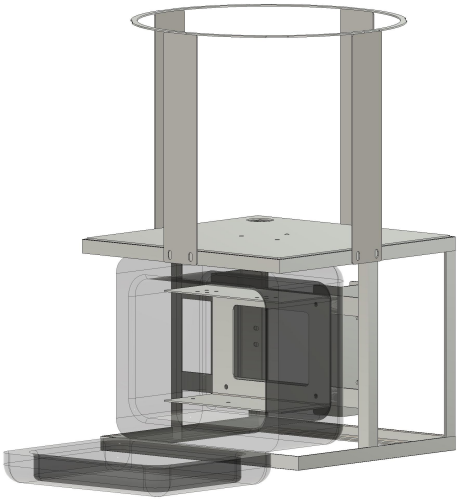

Figure 1. Autodesk Fusion 360 model of mounting system.

The main section of the mounting system is made out of 90° angle stock. This allows the construction of a lightweight but extremely strong skeletonized frame. Having a mounting system that is skeletonized is extremely important

to allow for thorough cleaning of the surfaces. The remaining components of the mounting system are made out of 14 Gauge and 22 Gauge sheet steel.

The ring at the very top of the mounting system is designed to fit inside the lip on the bucket of the portable sampler. This allows for an extremely convenient, tool-less and non-destructive anchoring method to hold the portable sampler in the mounting system. The latches on the lid of the sampler swing into the lip on the bucket and in the process, sandwich the ring.

The Pelican iM2075 Storm Case contains a bracket designed to securely hold components of the power delivery system. It was bent into a "U" shape and allows for upper and lower mounting points. The middle has a 4 bolt pattern which is centered around a rectangular cutout.

Behind the case are two brackets designed to securely hold the portable flow meter. The two brackets were bent into a "U" shape, and the inside space is utilized for cable management and the two waterproof cable grommets exiting the case. On one side, the two brackets share the same 4 bolt pattern used to hold the case and internal bracket in place. On the other side are mounting blocks designed to hold the flow meter in place using the existing quick release mechanism. These mounting blocks allow for a convenient, tool-less and non-destructive method to secure the portable flow meter to the mounting system.

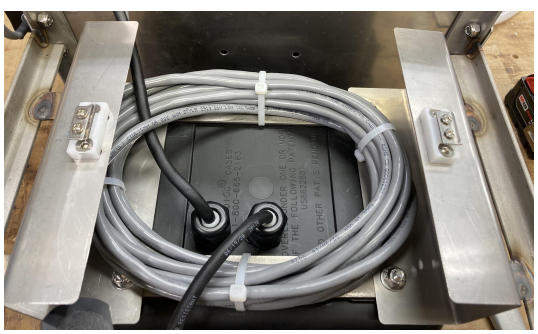

Figure 2. Flow Meter mounting brackets with blocks.

B. *Power Delivery System*

The power delivery system is designed to act as a unified power source for the flow meter and sampler, replacing their original separate power sources. For power delivery, the system makes use of a detachable Milwaukee brand 'M18' Lithium-ion battery pack. This style of battery pack is designed to slide onto an internal dock and clip into place, requiring only a few seconds of the operator's time to be installed or removed.

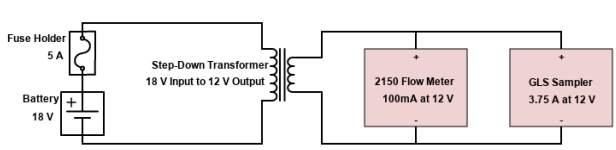

Figure 3. Wiring diagram of the power delivery system.

The battery has a rated output of 18VDC. This is incompatible with the 12VDC inputs of the flow meter and sampler, so the output is run through a step-down voltage converter and regulated power is passed to the equipment.

The battery pack is fused with a 5A blade fuse, which greatly reduces the risk of a short-circuit and of a thermal runaway incident. All power delivery system electronics are contained in the Pelican Storm Case, which is a fully waterproof case. As a result, the water-resistance rating of the equipment is not compromised.

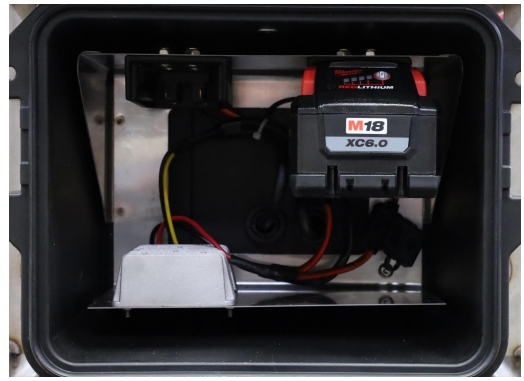

Figure 4. Inside of the Pelican Storm Case showing the electronics.

III. Conclusion

The mounting system dramatically improves the ease of deployment for flow-paced composite sampling by combining a flow meter and sampler into a single unit. Having a single unit allows the technician to make fewer trips into the manhole while setting up sampling. The power delivery system allows both the flow meter and sampler to run off a single M18 6Ah Lithium-Ion battery pack which reduces weight, saves space and provides more than double the runtime of the original batteries.

Acknowledgment

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References

[1] Teledyne ISCO. (1999). *2150 Area Velocity Flow Module and Sensor: Installation and Operation Guide*. Retrieved from https://www.teledyneisco.com/en-us/waterandwastewater/Flow%20Meter%20Documents/Manuals/2150%20Flow%20Module%20User%20Manual.pdf.

[2] Teledyne ISCO. (1998). *GLS Compact Sampler: Installation and Operation Guide*. Retrieved from https://www.teledyneisco.com/en-us/waterandwastewater/Sampler%20Documents/Manuals/GLS%20Compact%20Sampler%20User%20Manual.pdf