Technical Note 134

Bubbles in Turbidity Measurements

Introduction

Bubbles are a common source of interference in turbidity measurements. The presence of bubbles, either in the water or on the surfaces of the light source or the detectors, will generally cause a positive interference as they will cause additional scatter of light. When making measurements in samples with low turbidities this additional scatter can represent a significant error in the measurement.

Bubbles occur at the sensor due to the presence of dissolved air within the water. A higher pressure water can carry higher levels of dissolved gases than a lower pressure solution. This means that if the pressure is lowered, gases will start to come out of the solution. Similarly, a lower temperature solution can carry a higher level of dissolved gases than a warmer solution so raising the temperature of the solution will also cause these gases to come out of solution as bubbles. When the gas comes out of solution it can form either entrained bubbles or nucleated bubbles.

Entrained Bubbles

Entrained bubbles move within the solution and can be removed using a debubbler cell. The TurbSense® debubbler cell (shown in Fig. 1) contains a series of baffles for this purpose. As the liquid passes up, over, and under the baffles, entrained bubbles rise to the surface. These bubbles then burst on the surface or get carried out of the overflow. Either way they don't reach the sensor chamber.

Nucleated Bubbles

When water is put under pressure (e.g. when pumped) the water is able to hold more dissolved air than when it isn't under pressure. When the pressure is released the bubbles come out of the solution and build up at nucleation sites such as miniscule surface defects (like CO_2 comes out the solution when champagne is uncorked). Nucleated bubbles grow with time and can become detached and become entrained bubbles. If nucleating bubbles form on sensor surfaces they can cause large errors in readings. Pi deals with nucleating bubbles in one of two ways depending on the installation. For pole mounted installations in tanks and channels, installation of the Pi Autoclean means that bubbles can be removed from a TurbSense® sensor by carrying out an Autoclean operation and firing a jet of water over the sensor surface. In flow cell installations the flow cell can be kept under pressure thereby preventing the nucleating bubbles from forming in the first place.

The graph in Fig. 2 shows the variation in the amount of nucleated bubbles when the TurbSense® was installed in

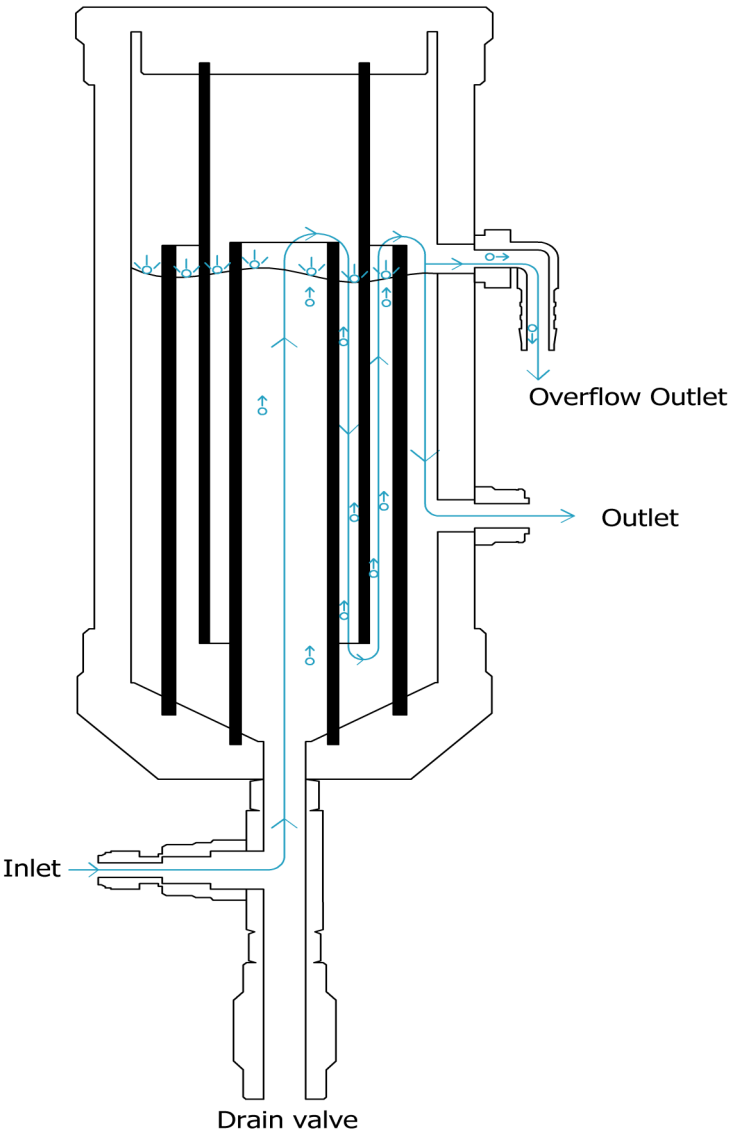

Fig. 1 Debubbler cell showing water flow

two flow cell installations. One installation used the TurbSense® in a non-pressurised flow cell, while the other utilised the Pi pressurised flow cell.

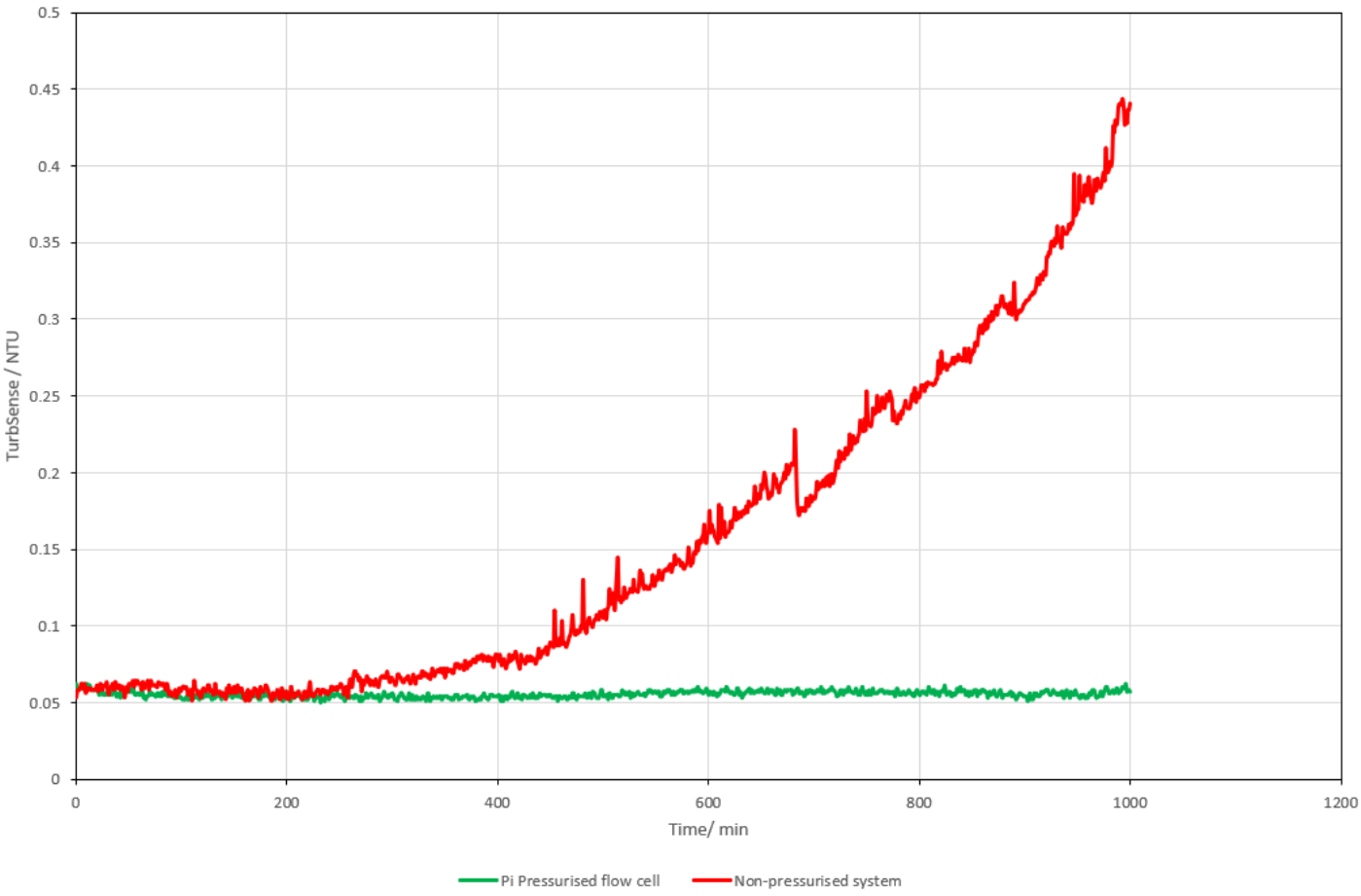

Fig. 2 Graph to show the difference in the amount of nucleated bubbles when a TurbSense® is used in a pressurised and non-pressurised flow cell

Conclusion

Whilst bubbles do interfere with turbidity measurements Pi has developed simple, robust methods of removing that potential interference.