Tracerco

Providing Insight Onsite

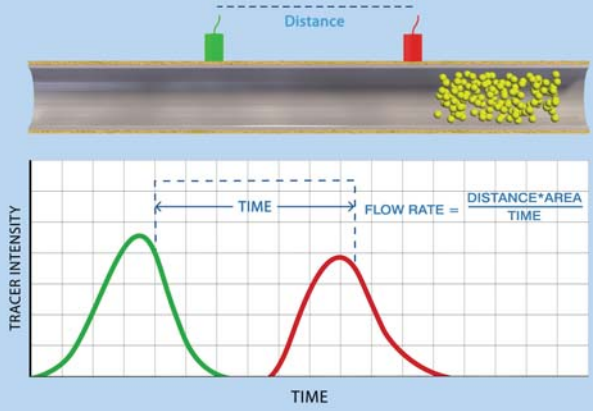
Pipeline - Flowrates

The use of radiotracer techniques for the measurement of pipeline flowrates is one of the most common and most useful applications of this technology. Although there are several ways in which this can be done, there are two methods that have been found to be particularly applicable to studies on process plants: the "pulse velocity" and "dilution" techniques.

The basic equipment arrangement for pulse velocity measurement is shown in the illustration. A radiotracer is injected into the process stream using a convenient injection point, such as a pressure gauge. Two sensitive detectors are positioned sufficiently far downstream of the injection point and as the tracer pulse passes the detectors, they respond to the presence of the tracer material and their output signals are sent to a data analyser. The time between the centroids of the response curves is the mean transit time of the tracer between the detectors, where the flow velocity is calculated. The linear velocity can be converted to volume flowrate by multiplying it by the mean cross-sectional area of the process line.

When using the dilution flow technique, a tracer is injected at a known and controlled rate into the flow to be measured. (Figure 1) Samples are taken downstream and measured for tracer concentration. Mass flow is determined by comparison of the initial and diluted tracer concentration and tracer injection flow rate into the system.

As the pulse velocity technique requires no sampling this is the more commonly used of the two because it is easier to apply and provides an immediate answer.



The pulse velocity method is the predominant technique used in pipeline flow measurement and to verify or calibrate a flow meter in-situ.

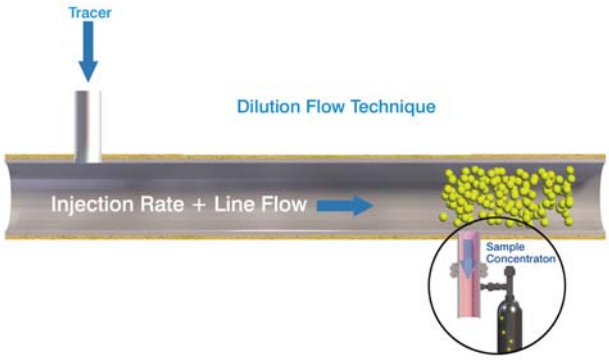


Figure 1 - The dilution flow technique injects a tracer material at a suitable injection point and measurement of dilution of the injected tracer through the system is made by taking samples from the downstream point over a suitable time period.

Process Diagnostics

Project Field Test

Under normal operation, spent liquor from an absorption tower (Figure 2) passes through the bed of a regeneration tower, is removed using a draw tray, then passed through a heater. The heated liquor is then returned to the lower half of the tower, finally exiting as the tower bottoms. However, the abnormally low temperature of the regenerated liquor suggested that some might be bypassing the heater. Normally, the flowrate of liquor through the heater should be equal to that of the bottom stream of the tower. These two flows, were checked by pulse velocity measurements using the equipment layout shown in Figure 2.

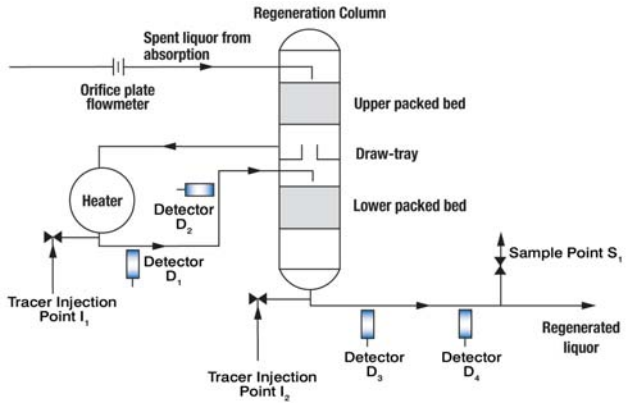


Figure 2 - Investigation results of flowrate studies through a regeneration column identified a problem with the draw tray while the plant was still online which enabled maintenance efforts to be directed immediately to the source of the problem, thereby reducing downtime.

Project Analysis

The results of the measurements showed:

- There was no movement of tracer between detectors D_1 and D_2. This showed that there was zero flow through the heater and suggested that the draw tray was badly damaged.
- The measured velocity between detectors D_3 and D_4 was abnormally high and implied that the flowrate was four times greater than that indicated by an orifice plate on the inlet to the tower.

This discrepancy was so great that it was decided to re-measure the bottoms flow using the dilution technique to obtain an absolute measurement of volume flowrate. This was done by injecting tracer at injection point I_2 and taking samples from the sample point S_1. The result of this measurement was in agreement with the orifice plate meter. The only explanation was that the cross sectional area of the bottoms take-off line that was used in the pulse velocity calculation was much too high. This implied that the bore of the bottoms exit pipe was restricted… possibly by deposits.

Customer Conclusion

On the strength of these measurements, the regeneration column was shut down as soon as possible so that the mechanical condition of the draw tray could be checked and the bottoms take-off line assessed for deposits. When these inspections were carried out it was found that the draw tray had collapsed on to the lower bed and that the exit line was partially filled with ceramic debris from the packing rings.

The Tracerco customer received a double benefit from this tracer study. The identification of a problem with the draw tray while the plant was still online enabled maintenance effort to be directed immediately to the source of the problem, thereby reducing downtime. Additionally, the detection of the deposits in the bottoms take-off initiated a thorough clean-up of the pipe work and thus forestalled potential blockages that ultimately could have led to an unscheduled plant shutdown, which would have incurred production losses of several million dollars.

For further information:

If you would like to obtain additional information on Tracerco's Process Diagnostics™ technology please contact a technical advisor in your area to schedule an onsite presentation or visit our website at www.tracerco.com.

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