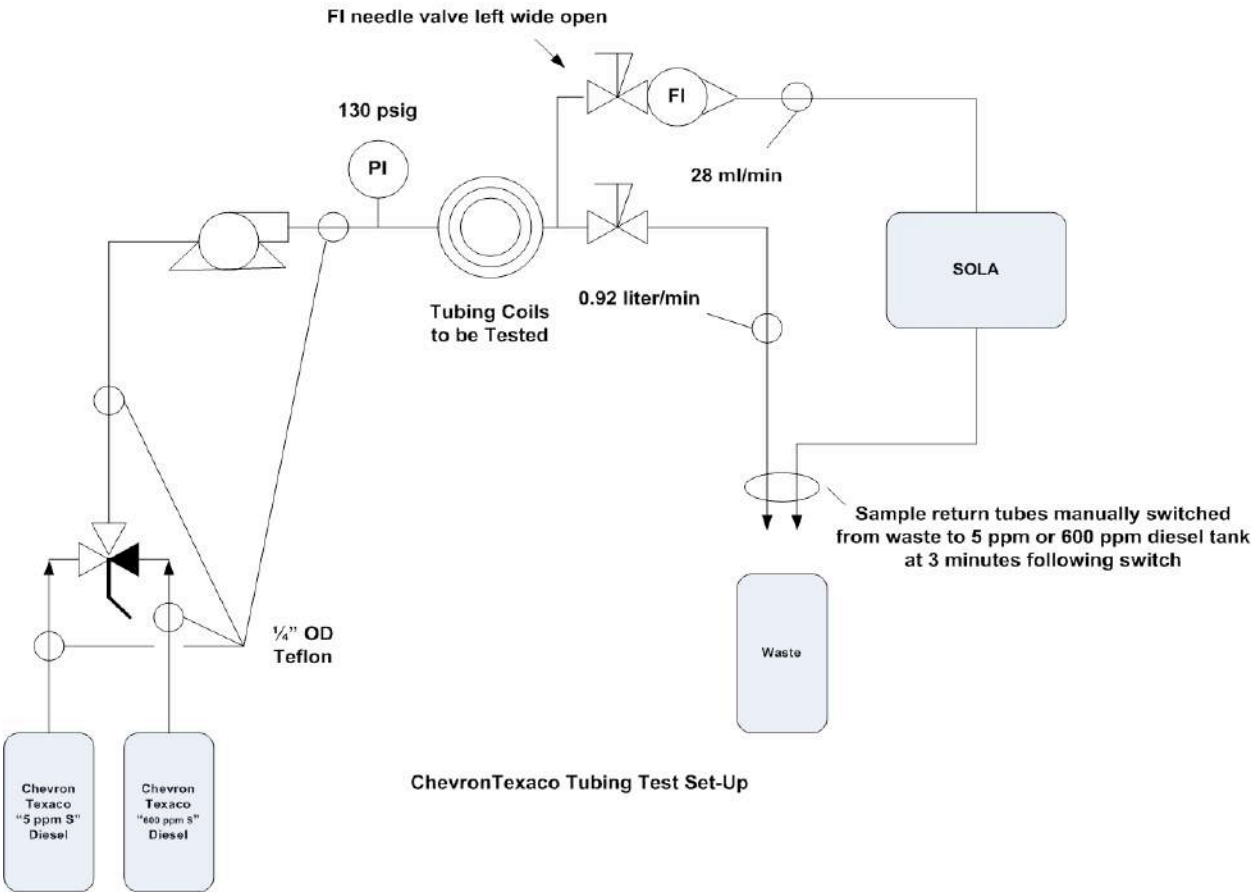
Sulphur in Diesel Sample Tube Memory Effect Tests

Sample system tubing memory effects on sulphur measurement in gas are well known and significant. The adsorption and possible reaction of sulphur with steel tubing led to the development of Sulfinert tubing coatings. However nothing was known about similar effects, or indeed whether there were any sulphur memory effects with liquid samples. I mentioned this to Thermo in Houston who agreed to conduct tests using the Sola II analyser. O'Brien analytical were approached as an interested party and they agreed to supply a range of tubing for the tests. Chevron Pascagoula refinery supplied the low and high sulphur diesel.

Prior to the test the tubes had been filled with diesel of a known concentration and left to soak for a number of weeks. The diesel was then taken from the tube and re analysed to check if the tubes had differing adsorption characteristics. These results showed no significant difference.

O'Brien supplied 3 Coils of ¼" tubing: 90 ft of Fused Silica, 100 ft of 316 SS and 100 Ft of Electropolished tube. The analyser was set at a 15 second inject time so there is a 15 second uncertainty in the timings. A test apparatus sketch is included below. Sample was run through the tubing until it reached a steady state. The sample was then switched and the time noted. The analyser captured the data. Rod Spitler of Thermo assembled the spreadsheet.



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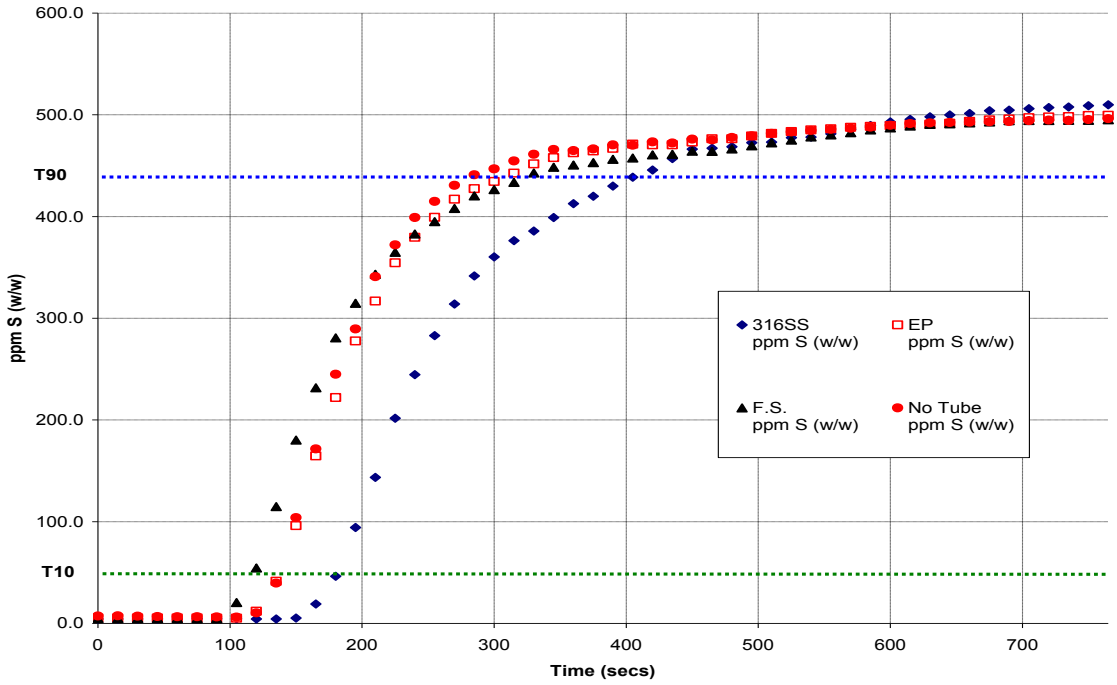

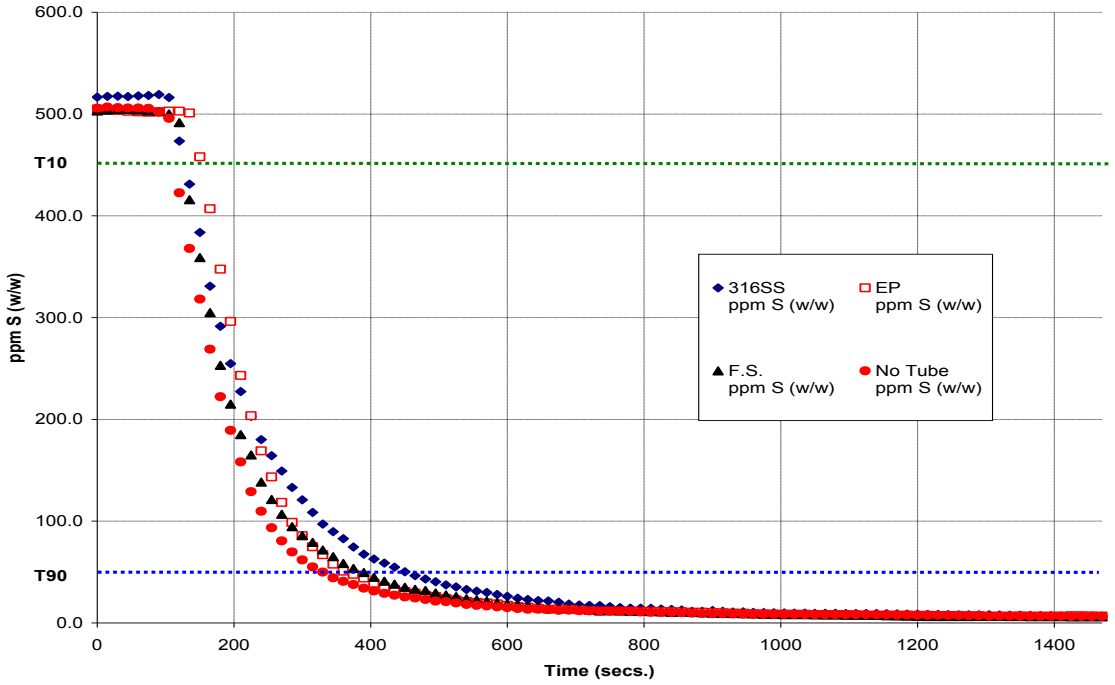

A summary of the results can be seen on the following bar chart.

Definition:
T90 is the time for a step change in the process variable to reach 90% of its final value. T10 is the time to reach 10% of its final value. Below is the T90 and T10 times bar chart. This method simplifies the assessment.

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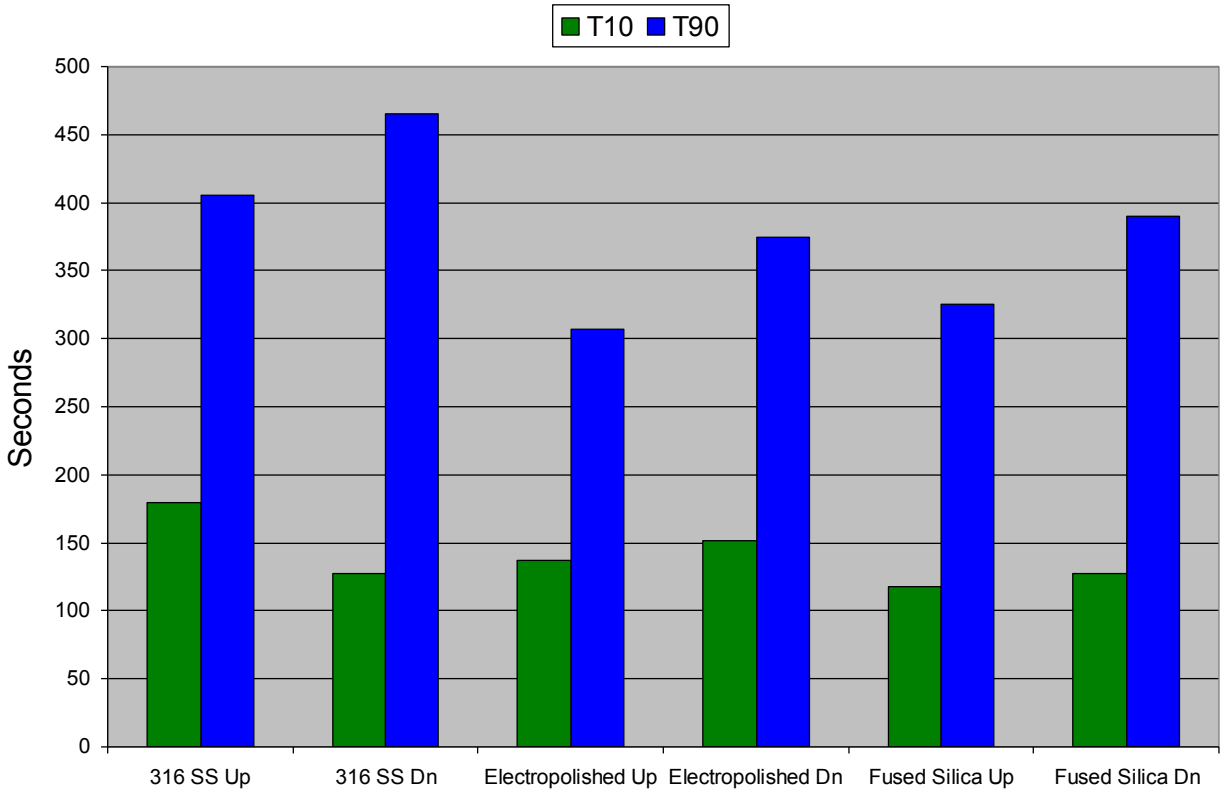
There is an approximate sampling system delay of 100 seconds. Running the system with no test tubing installed gave this.



Conclusions:
From the T Times compassion table there seems little difference between Electropolished and Fused Silica.

On the T90 down - the EP was 90 seconds faster than the 316SS.
On the T90 up - EP was 98 seconds faster than the 316SS.
On the T10 down - the 316SS was 25 seconds faster than the EP.
On the T10 up - the EP was 43 seconds faster than the 316SS.

The improvement in the T90 performance shows there is greater adsorption with the 316SS tube over Electropolished. In addition to this the 316SS tube is not as clean as the Electropolished. Oil and chemicals used in the tube manufacture could still be attached to the walls. Although this would flush through it could cause confusion on commissioning. As the Electropolished tube is cheaper than the Fused Silica, the recommendation is:

Electropolished tube should be used for single digit PPM total sulphur measurement sample transport tubing.