DP Meters with Prognosis In Water / Oil Liquid Flow Applications

Water often flows with oil. This water cut flow is metered by a flow meter giving total liquid volume flow, a sample system for estimating the water cut, and combining this information to predict the oil and water flow rates. For low flow rate prediction uncertainties it is desirable for the flow meter to have comprehensive diagnostics.

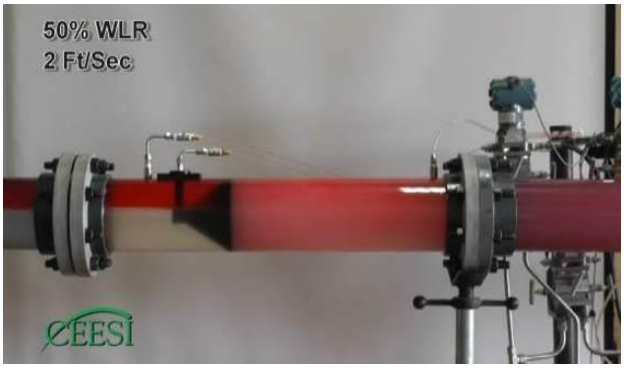

Fig 1. Cone meter, 0.6 m/s, WLR_m 0.5.

Fig 2. Cone meter 1.6 m/s, WLR_m 0.2.

CEESI and DP Diagnostics tested a clear body 6", 0.483β cone DP meter in horizontal oil with water flows. Figures 1 & 2 show still oil (dyed red) and water flowing through a cone meter. Video is available: **Link 3**. The 'WLR_m' is the ratio of water to total liquid mass flow.

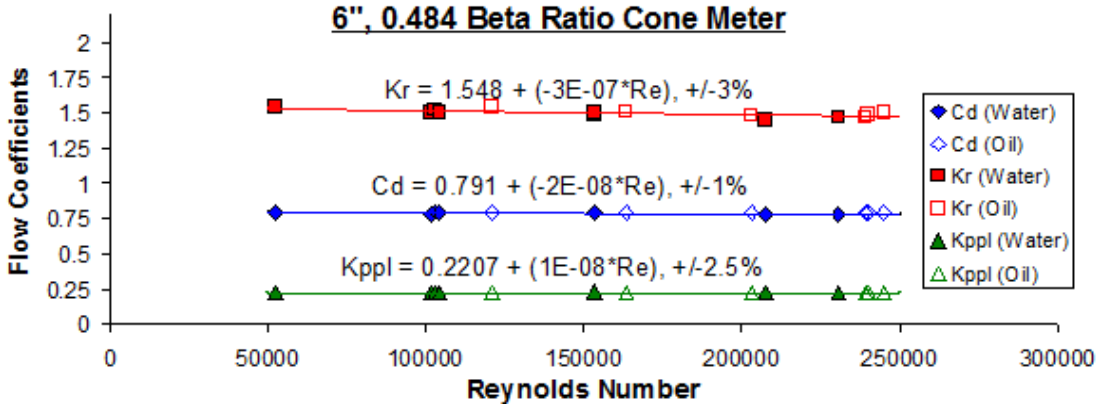

Fig 3. 6", 0.483β Cone Meter Flow Coefficients in Homogenous Liquid Flow.

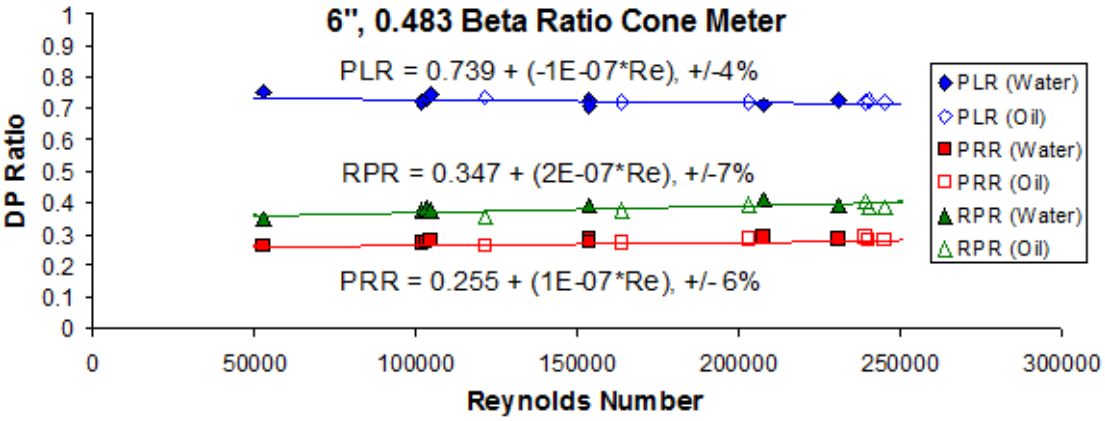

Fig 4. 6", 0.483β Cone Meter DP Ratios in Homogenous Liquid Flow.

Figures 1 & 2 show the oil only and water only Prognosis system calibration results. Figure 5 shows resulting sample single component (water and separately oil) Prognosis plots. The meter was fully diagnostic ready when tested with oil with water mixtures.

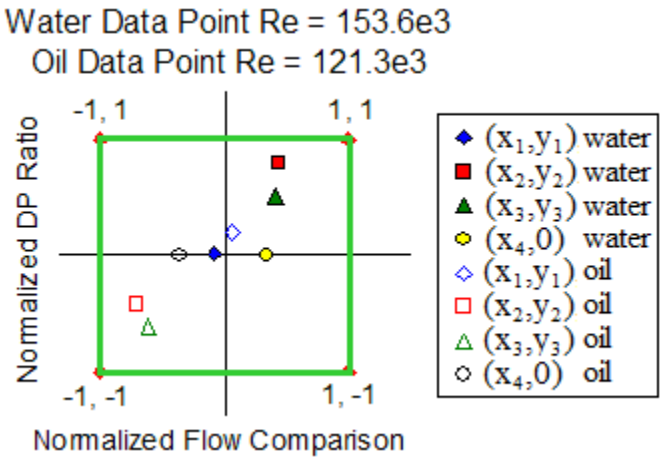

Fig 5. Examples of Baseline Diagnostic Results.

Cousins et al (Link 4) discusses how, although not fashionable, the DP meter's response to oil with water flow is as good as turbine and ultrasonic meters, and the DP meter diagnostic system Prognosis is fully operational in water and oil mixture applications. For example, Figure 6 shows the Prognosis results for the correctly operating cone DP meter with various water cut flow conditions.

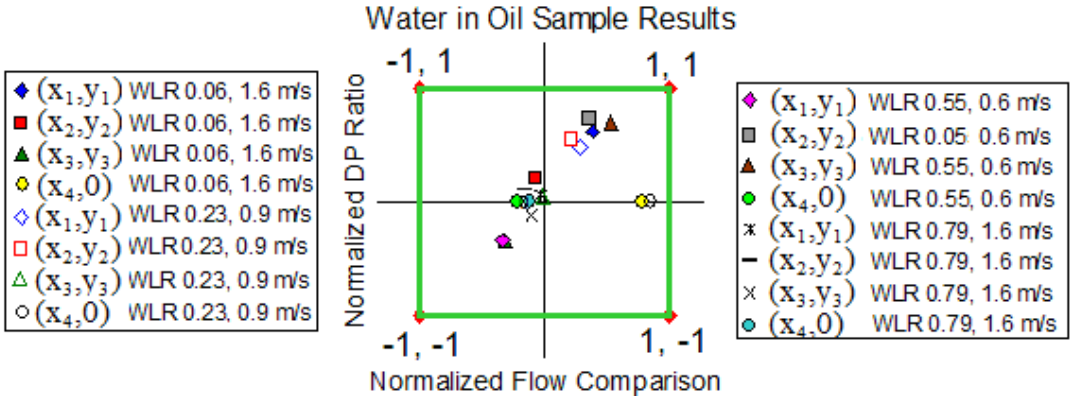

Fig 6. Sample Data from a 6", 0.483β Cone Meter Tested with Oil with Water Flows.

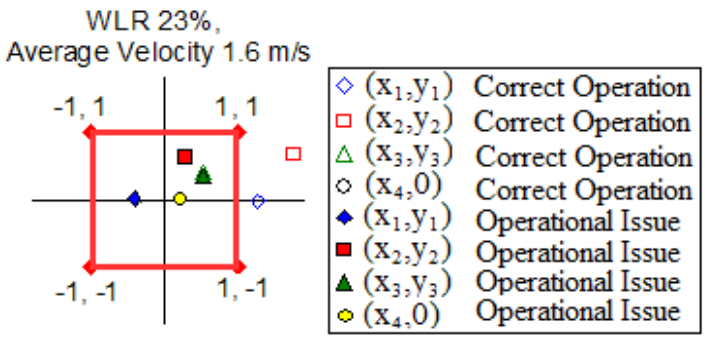

Fig 15. Incorrect Discharge Coefficient..

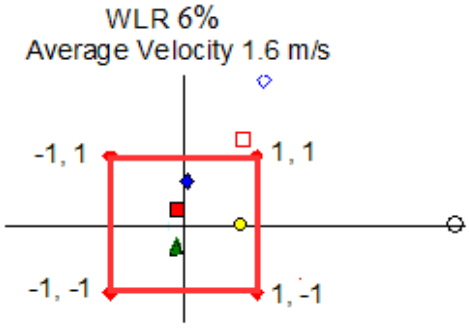

Fig 16. Incorrect DP_t Read.

Figure 7 & 8 show examples of the cone DP meter Prognosis system picking up metering problems. Figure 7 shows the case of a correct and then incorrect discharge coefficient being used (with a WLR_m 23% flow) inducing a volume flow prediction bias of -4.6%. Figure 8 shows the case where the primary DP reading is read correctly and then incorrectly (with a WLR_m of 6%) inducing a volume flow prediction bias of -2.8%. Prognosis indicates the existence of these sample metering problems.