COMPARISON OF TECHNIQUES IN DETERMINING WATER QUALITY FOR OIL WELLS

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Extract

"Water Quality" for water treatment, as related to suspended material, is a term that is difficult to define. The "Beta" and "Water Quality Ratio" methods are being used as measures of water quality.

These methods may be used to observe day-to-day changes, but cannot be compared to results obtained in other fields because water-suspended particles have different size distributions, shape and plasticity. These factors appear to be as important as the concentration of particles.

For example, in some recent studies of water filtration in preparation for the Coalinga polymer flood, we were unable to generate diatomaceous earth filtered water with a "Beta" factor of 0.7. This has long been our minimum acceptable water quality target at Ventura. By evaluating several Coalinga waters by three techniques (Beta factor, turbity, and particle size distribution) we determined that residual particles (<2µ in diameter) were causing filtered water to produce poor Millipore factors. The purpose of this report is to present preliminary data on the subject.

Equipment used for the measurements were:

1. Beta Factor – by Millipore Filtration.
2. Turbidity – by "Hach" Laboratory Turbidimeter, Model 2100A.
3. Particle Count – by Spectrex Particle Counter, Model ILI 1000.

The following observations were made during D.E. filtration test runs in Coalinga:

1. *Fig. 1* shows the results obtained from USBR water before and after filtration.

    a. The Spectrex Particle Counter shows a large reduction in particles after filtration. The instrument can be set to count particles from 1 to 100 micron size equal to or greater than that size.

    b. Turbidity decreased from 0.40 FTU to 0.08 FTU (compared to 0.06 for distilled water).

    c. The Beta Factor for all practical purposes did not improve, only changed from 0.52 to 0.57.

1. *Fig. 2* shows the effect of D.E. leakage and the inconsistency of Beta Factor measurements.

a. The filtered water showed a larger number of particles compared to the unfiltered water by the particle counting method.
b. The Beta Factor showed a substantial improvement in water quality from 0.41 to 0.86.

Note: The D.E. that leaked through the filter leaves increased the solids content of the filtered water. When the Millipore analysis was run to determine the Beta Factor, the

D.E. settled on the Millipore membrane, acting as a pre-filter. Consequently, very little filtering of solids, other than D.E., occurred on the surface of the membrane itself, resulting in a high Beta Factor, due to a deep bed filtration effect.

2. *Fig. 3* shows the quality of 160,000 ppm brine before and after filtration.

   a. A large reduction in particles was observed by Spectrex Counter after filtration.
   b. The Beta Factor of the filtered brine was only 0.08. (No Beta Factor was determined on the unfiltered brine due to the high solids loading.)

   Note: Attempts to determine meaningful Beta Factors on high salinity brines proved unsuccessful. The Spectrex counts indicated good filtration. For that reason the filtrate (through 0.45 micron Millipore) from b. above was collected and particle count measured again. The improvement was marginal, showing good D.E. filtration in the first place, but not measurable by the Millipore filtration test for some yet unknown reason. Perhaps salinity causes swelling of the Millipore paper and closing of the hole sizes in the paper.

3. *Fig. 4* shows a general comparison between Beta Factor, turbidity and particle count for unfiltered, filtered and distilled water.

   Note: In all three cases, particle count and turbidity follow the same trend, but the Beta Factor shows the water (middle curve) to be unacceptable as injection water, Beta-054 (General accepted Beta Factor range is 0.7 – 1.0), yet compares favorably with distilled water, using particle count and turbidity as criteria.

Conclusion:

In Coalinga the problem is not obtaining good quality water but the method of determining it. It appears that essentially all the particles down to about 2.0 microns are being filtered out, leaving particles of 2.0 or less, which are small enough to plug a 0.45 micron Millipore membrane, resulting in poor Beta Factors. Larger particles left in the water would actually help filtration through a 0.45 micron membrane, resulting in a higher Beta Factor as evidenced with D.E. leakage.

In other words meaningful Beta Factors can only be obtained when the particle size distribution, as well as the concentration is known.

Methods for testing water quality should be determined for each field. From initial data it appears that the Beta Factor procedure works well for the Ventura Field, but will be investigated further, along with other locations.

T. Bates

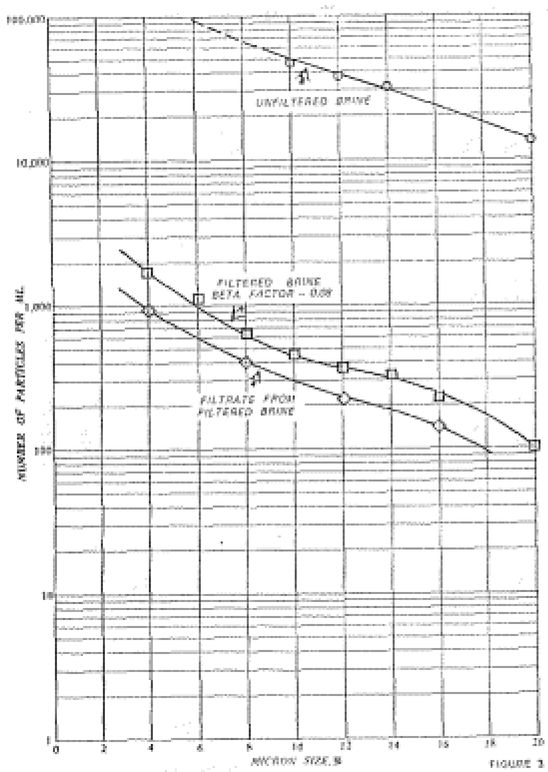

FIGURE 3

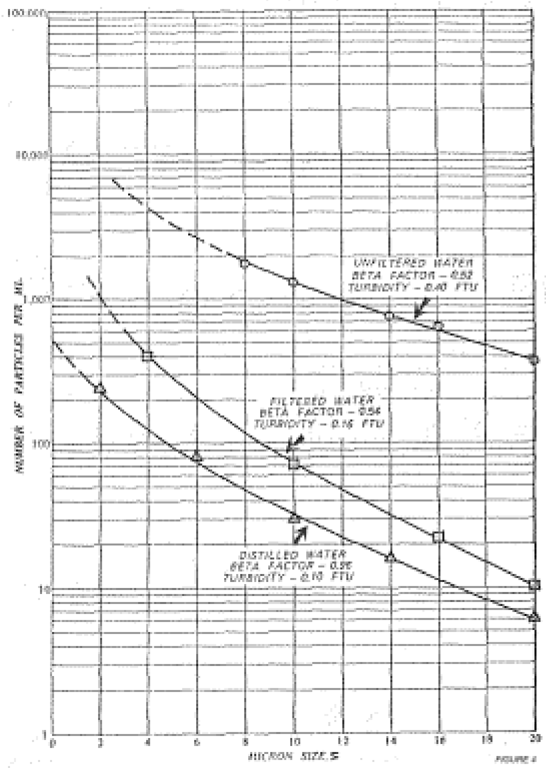

FIGURE 4

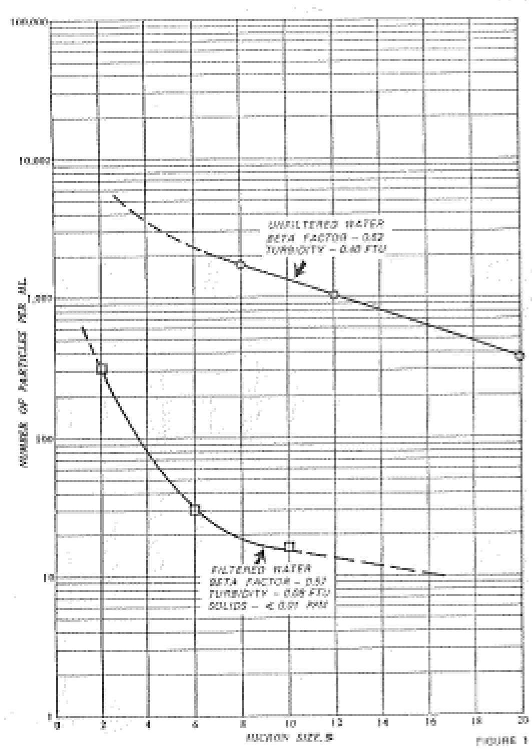

FIGURE 1
ZM-330-A

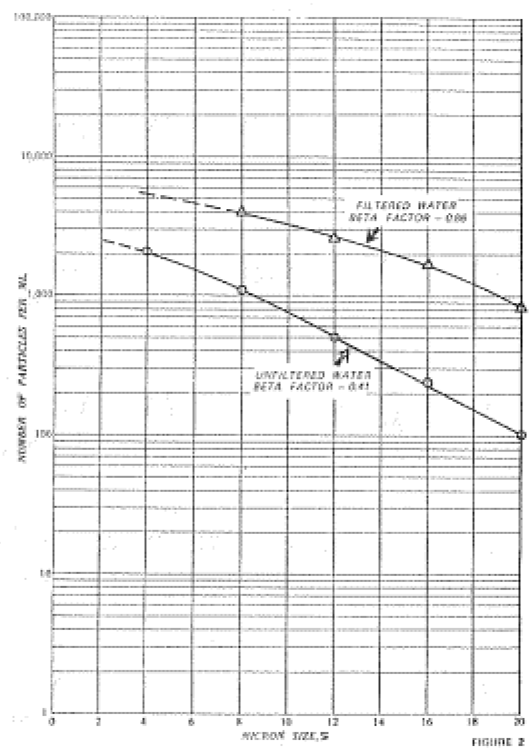

FIGURE 2
ZM-330-B