time, then the first and second fluid meters 5, 6 may measure the densities at substantially the same time.

However, if only one of the fluid meters is present, then both of the density state measurements will be taken by the single fluid meter at different times (before and after the density adjustor 104 adjusts the density state of the multicomponent fluid by adjusting the pressure and/or temperature).

Using the example of the oil, water, and gas again, the amount of oil and water is typically of interest, which as mentioned above, requires a known combined density of the liquid (incompressible components). Therefore, according to one embodiment, equations (5-11) can be reduced to a single equation (12) which can be solved for ρ_{INCOMP}.

$$0 = \left(1 - \frac{\rho_2 - \rho_{INCOMP}}{\frac{P_1}{RT_1} - \rho_{INCOMP}\frac{P_2 T_2}{T_1 T_2}}\right)\rho_{INCOMP} + \left(\frac{\rho_2 - \rho_{INCOMP}}{1 - \rho_{INCOMP}\frac{T_2 R}{P_2}}\right) - \rho_1 \qquad (12)$$

Those skilled in the art will readily recognize that equation (12) is an implicit equation that requires a solver. Equation (12) can also be rewritten into an explicit solution using some substitutions as follows

$$z = \frac{P_2 T_1}{P_1 T_2} \qquad (13)$$

$$a = z - 1 \qquad (14)$$

$$b = \rho_{C2} - z\rho_2 - z\rho_{C1}\rho_1 \qquad (15)$$

$$c = z\rho_{C1}\rho_2 - \rho_{C2}\rho_1 \qquad (16)$$

Using equations (13-16), equation (17) provides an explicit solution for the incompressible components' density.

$$\rho_{INCOMP} = \frac{-b\sqrt{b^2 - 4ac}}{2a} \qquad (17)$$

With the density of the incompressible components of the fluid calculated the water and oil volume fractions from equations (1) and (2) can be determined. Additionally, any of the unknown fluid characteristics listed above, such as the volume fraction of compressible components, can be determined. After these unknowns are determined, certain additional parameters can then be calculated, such as the water cut

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Using equations (13-16), equation (17) provides an explicit solution for the incompressible components' density.

$$\rho_{INCOMP} = \frac{-b(\pm)\sqrt{b^2 - 4ac}}{2a} \qquad (17)$$

The "+" sign in equation 17 is used when the density of the compressible component in the first density state is less than the density of the compressible component in the second density state. The "-" sign in equation 17 is used when the density of the compressible component in the first density state is greater than the density of the compressible component in the second density state.

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