We claim:

1. A system (700) for using a vapor pressure to determine a concentration of a component in a multi-component fluid, the system (700) comprising:

an electronics (710) communicatively coupled to a transducer (720) configured to sense a multi-component fluid, the electronics (710) being configured to:

determine a first vapor pressure, the first vapor pressure being a vapor pressure of a first component of the multi-component fluid;

determine a second vapor pressure, the second vapor pressure being a vapor pressure of a second component of the multi-component fluid;

determine a multi-component vapor pressure, the multi-component vapor pressure being a vapor pressure of the multi-component fluid, based on a gain of a drive signal provided to the transducer; and

determine a concentration of at least one of the first component and the second component based on the multi-component vapor pressure, the first vapor pressure, and the second vapor pressure.

2. The system (700) of claim 1, wherein the electronics (710) being configured to determine the concentration of at least one of the first component and the second component based on the multi-component vapor pressure, the first vapor pressure, and the second vapor pressure comprises the electronics (710) being configured to use equations:

$$P_m = P_1^* x_1 + P_2^* x_2; \text{ and}$$

$$x_1 + x_2 = 1;$$

where:

P_m is the multi-component vapor pressure and is a sum of the pressures exerted by each component of the multi-component fluid being a two-component fluid;

P_1^*, P_2^* are respectively the first vapor pressure and the second vapor pressure when the first component and the second component are pure fluids; and

x_1, x_2 are respectively mole fractions of the first and second component in the two-component fluid.

3. The system (700) of claim 1, wherein the electronics (710) being configured to determine a concentration of at least one of the first component and the second component based on the multi-component vapor pressure, the first vapor pressure, and the second vapor pressure comprises the electronics (710) being configured to determine the concentrations of the first component, the second component, and a third component using equations:

$$P_m = P_1^* x_1 + P_2^* x_2 + P_3^* x_3;$$

$$x_1 + x_2 + x_3 = 1;$$

$$MW_{mix} = x_1 MW_1 + x_2 MW_2 + x_3 MW_3; \text{ and}$$

$$\frac{1}{\rho_T} = \frac{w_1}{\rho_1} + \frac{w_2}{\rho_2} + \frac{w_3}{\rho_3};$$

where:

P_m is the multi-component vapor pressure of the multi-component fluid where the multi-component fluid is a three-component fluid;

x_1, x_2, and x_3 are respective mole fractions of the first component, the second component, and the third component of the three-component fluid;

P_1^*, P_2^*, and P_3^* are respectively the first vapor pressure, the second vapor pressure, and a third vapor pressure where the first component, the second component, and the third component are pure fluids;

MW_{mix} is a molecular weight of the three-component fluid;

MW_1, MW_2, and MW_3 are respective molecular weights of the first component, the second component, and the third component;

w_1, w_2, and w_3 are respective mass fractions of the first component, the second component, and the third component in the three-component fluid and are respectively equal to $x_1 MW_1/MW_{mix}$, $x_2 MW_2/MW_{mix}$, and $x_3 MW_3/MW_{mix}$;

ρ_1, ρ_2, and ρ_3 are respective densities of the first component, the second component, and the third component of the three-component fluid; and

ρ_T is a density of the three-component fluid.

4. The system (700) of one of any of the foregoing claims 1 through 3, wherein the electronics (710) is further configured to determine a density of the multi-component fluid in the transducer (720) based on sensor signals provided by the transducer (720).

5. The system (700) of one of any of the foregoing claims 1 through 4, wherein the electronics (710) is further configured to determine a true vapor pressure of the multi-component fluid based on a static pressure of the multi-component fluid in the transducer (720).

6. The system (700) of one of any of the foregoing claims 1 through 5, wherein the electronics (710) is a meter electronics (20) and the transducer (720) is a meter assembly (10) of a vibratory meter (5).

7. A method of using a vapor pressure to determine a concentration of a component in a multi-component fluid, the method comprising:

determining a first vapor pressure, the first vapor pressure being a vapor pressure of a first component of the multi-component fluid;

determining a second vapor pressure, the second vapor pressure being a vapor pressure of a second component of the multi-component fluid;

using a transducer having the multi-component fluid to determine a multi-component vapor pressure, the multi-component vapor pressure being a vapor pressure of the multi-component fluid, based on a gain of a drive signal provided to the transducer; and

determining a concentration of at least one of the first component and the second component based on the multi-component vapor pressure, the first vapor pressure, and the second vapor pressure.

8. The method of claim 7, wherein determining the concentration of at least one of the first component and the second component based on the multi-component vapor pressure, the first vapor pressure, and the second vapor pressure comprises using equations:

$$P_m = P_1^* x_1 + P_2^* x_2; \text{ and}$$

$$x_1 + x_2 = 1;$$

where:

P_m is the multi-component vapor pressure and is a sum of the pressures exerted by each component of the multi-component fluid being a two-component fluid;

P_1^*, P_2^* are respectively the first vapor pressure and the second vapor pressure when the first component and the second component are pure fluids; and

x_1, x_2 are respectively mole fractions of the first and second component in the two-component fluid.

9. The method of claim 7, wherein determining the concentration of at least one of the first component and the second component based on the multi-component vapor pressure, the first vapor pressure, and the second vapor pressure comprises determining the concentrations of the first component, the second component, and a third component using equations:

$$P_m = P_1^* x_1 + P_2^* x_2 + P_3^* x_3;$$

$$x_1 + x_2 + x_3 = 1;$$

$$MW_{mix} = x_1 MW_1 + x_2 MW_2 + x_3 MW_3; \text{ and}$$

$$\frac{1}{\rho_T} = \frac{w_1}{\rho_1} + \frac{w_2}{\rho_2} + \frac{w_3}{\rho_3};$$

where:

P_m is the multi-component vapor pressure of the multi-component fluid where the multi-component fluid is a three-component fluid;

x_1, x_2, and x_3 are respective mole fractions of the first component, the second component, and the third component of the three-component fluid;

P_1^*, P_2^*, and P_3^* are respectively the first vapor pressure, the second vapor pressure, and a third vapor pressure where the first component, the second component, and the third component are pure fluids;

MW_{mix} is a molecular weight of the three-component fluid;

MW_1, MW_2, and MW_3 are respective molecular weights of the first component, the second component, and the third component;

w_1, w_2, and w_3 are respective mass fractions of the first component, the second component, and the third component in the three-component fluid and are respectively equal to $x_1 MW_1/MW_{mix}$, $x_2 MW_2/MW_{mix}$, and $x_3 MW_3/MW_{mix}$;

ρ_1, ρ_2, and ρ_3 are respective densities of the first component, the second component, and the third component of the three-component fluid; and

ρ_T is a density of the three-component fluid.

10. The method of one of any of the foregoing claims 7 through 9, further comprising determining a density of the multi-component fluid in the transducer based on sensor signals provided by the transducer.

11. The method of one of any of the foregoing claims 7 through 10, further comprising determining a true vapor pressure of the multi-component fluid based on a static pressure of the multi-component fluid in the transducer.

12. The method of one of any of the foregoing claims 7 through 11, wherein the transducer is a meter assembly of a vibratory meter.