We Claim:

1. A method of measuring a percent solids content (PSC) of solids by mass in a slurry catalyst composition having solids and a suspension liquid for the solids, wherein the solids of the slurry catalyst composition include a catalyst for use with a polymerizable feedstock in a polymerization reactor to produce a polymer, the method comprising:

preparing a test sample of the slurry catalyst composition;

obtaining a first time domain (TD) $^{1}$H-nuclear magnetic resonance (NMR) spectrum using a time domain (TD)-NMR spectrometer and the test sample of the slurry catalyst composition used in producing the polymer in the polymerization reactor, where the first TD $^{1}$H-NMR spectrum is measured in the TD-NMR spectrometer at a temperature in the range of 10 $^{o}$C to 70 $^{o}$C;

determining a value of a voltage signal (a) from the first TD $^{1}$H-NMR spectrum that represents the slurry catalyst composition;

preparing a neat sample of the suspension liquid for the solids of the slurry catalyst composition;

obtaining a second TD $^{1}$H-NMR spectrum using the TD-NMR spectrometer for the neat sample of the suspension liquid for the solids of the slurry catalyst composition, where the second TD $^{1}$H-NMR spectrum is measured in the TD-NMR spectrometer at the same temperature used in obtaining the first TD $^{1}$H-NMR spectrum;

determining a value of a voltage signal (b) from the second TD $^{1}$H-NMR spectrum that represents the suspension liquid for the solids of the slurry catalyst composition; and

determining the percent solids content (PSC) of solids by mass in a slurry catalyst composition with Equation I:

$$PSC = (1 - a / b \times d_b / d_a) \times 100\% \qquad \text{Equation I}$$

where x represents mathematical multiplication, a and b are as described above, $d_b$ is a density of the suspension liquid for the solids of the slurry catalyst composition and $d_a$ is a density of the slurry catalyst composition used in producing the polymer in the polymerization

reactor, where the densities $d_b$ and $d_a$ are both measured at the temperature used in obtaining the first TD $^1$H-NMR spectrum.

2. The method of claim 1, wherein the preparing the test sample of the slurry catalyst composition for use in producing the polymer in the polymerization reactor includes:

diluting a predetermined mass of the slurry catalyst composition with a mass of the suspension liquid at a mass ratio of 10:1 to 25:1 (predetermined mass of the slurry catalyst composition : mass of suspension liquid) to produce a diluted sample; and

preparing the test sample of the slurry catalyst composition with the diluted sample.

3. The method of claim 2, wherein the preparing the diluted sample of the slurry catalyst composition includes rolling the diluted sample and removing gas bubbles from the diluted sample of the slurry catalyst composition.

4. The method of claim 1, wherein the obtaining the first TD $^1$H-NMR spectrum and the obtaining the second TD $^1$H-NMR spectrum includes using for the TD-NMR spectrometer a bench-top TD $^1$H-NMR spectrometer.

5. The method of claim 1, wherein the PSC of the slurry catalyst composition used in preparing the test sample of the slurry catalyst composition is characterized by the method as having a range of 10 percent (%) to 50 % of solids on a mass to mass basis.

6. The method of claim 1, wherein the obtaining the first TD $^1$H-NMR spectrum using the TD-NMR spectrometer and the test sample of the slurry catalyst composition and obtaining the second TD $^1$H-NMR spectrum using the TD-NMR spectrometer for the neat sample of the suspension liquid for the solids of the slurry catalyst composition includes measuring the first TD $^1$H-NMR spectrum and the second TD $^1$H-NMR spectrum in the TD-NMR spectrometer at a same temperature in the range of 10 $^o$C to 70 $^o$C.

7. The method of claim 1, wherein the suspension liquid for the solids includes a hydrocarbon carrier liquid.

8. The method of claim 1, including producing the polymer in the polymerization reactor with the slurry catalyst composition and the polymerizable feedstock;

determining a production rate (mass/hour) of the polymer being produced in the polymerization reactor with the slurry catalyst composition and the polymerizable feedstock;

determining a slurry flow rate (mass/hour) of the slurry catalyst composition to the polymerization reactor that provides the production rate (mass/hour) of the polymer being produced in the polymerization reactor; and

determining a productivity of the slurry catalyst composition with Equation II:

$$Productivity\ \left(\frac{mass\ polymer}{mass\ catalyst}\right) = \frac{Production\ rate\ of\ the\ polymer\ (\frac{mass}{hour})}{Slurry\ Flow\ Rate\ \left(\frac{mass}{hour}\right) * PSC} \quad \text{Equation II.}$$

9. A method, comprising:

producing a polymer in a polymerization reactor with a slurry catalyst composition and a polymerizable feedstock;

determining a production rate (mass/hour) of the polymer being produced in the polymerization reactor with the slurry catalyst composition and the polymerizable feedstock;

measuring a percent solids content (PSC) of solids by mass in the slurry catalyst composition having solids and a suspension liquid for the solids, wherein the solids of the slurry catalyst composition include the catalyst used with a polymerizable feedstock in the polymerization reactor to produce the polymer, where measuring the PSC includes:

preparing a test sample of the slurry catalyst composition;

obtaining a first time domain (TD) $^{1}$H-nuclear magnetic resonance (NMR) spectrum using a time domain (TD)-NMR spectrometer and the test sample of the slurry catalyst composition used in producing the polymer in the polymerization reactor, where the first TD $^{1}$H-NMR spectrum is measured in the TD-NMR spectrometer at a temperature in the range of 10 $^{o}$C to 70 $^{o}$C;

determining a value of a voltage signal (a) from the first TD $^{1}$H-NMR spectrum that represents the slurry catalyst composition;

preparing a neat sample of the suspension liquid for the solids of the slurry catalyst composition;

obtaining a second TD $^{1}$H-NMR spectrum using the TD-NMR spectrometer for the neat sample of the suspension liquid for the solids of the slurry catalyst composition, where the second TD $^{1}$H-NMR spectrum is measured in the TD-NMR spectrometer at the same temperature used in obtaining the first TD $^{1}$H-NMR spectrum;

determining a value of a voltage signal (b) from the second TD $^{1}$H-NMR spectrum that represents the suspension liquid for the solids of the slurry catalyst composition; and

determining the percent solids content (PSC) of solids by mass in a slurry catalyst composition with Equation I:

$$PSC = (1 - a / b \times d_b / d_a) \times 100\% \qquad \text{Equation I}$$

where x represents mathematical multiplication, a and b are as described above, $d_b$ is a density of the suspension liquid for the solids of the slurry catalyst composition and $d_a$ is a density of the slurry catalyst composition used in producing the polymer in the polymerization reactor, where the densities $d_b$ and $d_a$ are both measured at the temperature used in obtaining the first TD $^{1}$H-NMR spectrum;

determining a slurry flow rate (mass/hour) of the slurry catalyst composition to the polymerization reactor that provides the production rate (mass/hour) of the polymer being produced in the polymerization reactor;

determining a productivity of the slurry catalyst composition with Equation II:

$$Productivity\ \left(\frac{mass\ polymer}{mass\ catalyst}\right) = \frac{Production\ rate\ of\ the\ polymer\ (\frac{mass}{hour})}{Slurry\ Flow\ Rate\ \left(\frac{mass}{hour}\right) * PSC} \qquad \text{Equation II.}$$

10. The method of claim 9, wherein the obtaining the first TD $^{1}$H-NMR spectrum and the obtaining the second TD $^{1}$H-NMR spectrum includes using for the TD-NMR spectrometer a bench-top TD $^{1}$H-NMR spectrometer.