results in reduced polymer fines while, at the same time, possessing good polymerization response and efficiency.

[0005] One type of catalyst or catalyst that is used in the UNIPOL process, namely UCAT J-25 brand catalyst, is a relatively brittle, hollow particle (pro)catalyst. As such, it is a fragile material that, depending on the percentage of particles that break during handling, may exhibit nonuniformity in particle size distribution (PSD). This variation in PSD can lead to undesirable variation in polymerization results. Visual methods of characterizing or determining the degree of bimodality, which is one measure of nonuniformity, may be unsatisfactory, as they tend to yield inconsistent results. Visual methods rely on a person looking at a PSD output and making a determination of the bimodality or unimodality of the PSD. A limitation of the visual method is that there are only three possible results; namely unimodal, bimodal or polymodal, whereas modality is a continuous function. A lot of information about the data is lost using the visual method. One drawback associated with the visual method is that it is subject to differing interpretations depending on the person reviewing the results. Thus, there is intrinsic uncertainty in relying on visual interpretation. Often times, false positives and negatives occur. These are situations in which the visual determination is erroneous.

[0006] For example, small, but noticeable, second peaks may lead to a batch of catalyst being categorized as "bimodal," but in some cases these catalysts are in fact suitable for use in making plastic resin of the desired quality. Wide "shoulders" are actually two peaks so close to each other that no trough exists between them, and these batches will, in fact, impact final plastic resin quality. However, without a noticeable trough, these will be labeled "unimodal or "shoulder" using the visual method. Knapp, T.R., discusses bimodality and methods of determining it in his article "Bimodality Revisited" in the *Journal of Modern Applied Statistical Methods*, Vol. 6, Issue 1 (2007).

[0007] It would be desirable to have an improved method of characterizing the PSD of nonuniform particulate solids. One application of such a method could be an improved method of screening batches of catalyst for their suitability for use in polymerization.

SUMMARY

[0008] The method of the disclosure is such an improved method comprising, for a PSD of a plurality of particles of a nonuniform solid phase material, wherein the PSD is for a group of particles having a volume percent equal to 100 vol%, removing a top volume percentage and a bottom volume percentage from PSD to obtain a true PSD. Surprisingly, this method may be employed to identify batches of catalyst that are more effective for polyethylene polymerization.

[0008a] In one aspect, the present disclosure refers to a method comprising, for a particle size

distribution (PSD) of a plurality of particles of a nonuniform solid phase material, wherein the PSD is for a group of particles having a volume percent equal to 100 vol%, removing a top volume percentage and a bottom volume percentage from PSD to obtain a true PSD; wherein the top volume percentage comprises the particles in at least the highest 0.5 vol% of the particles of the PSD and the bottom volume percentage comprises the particles in at least the lowest 2.5 vol% of the particles of the PSD; wherein the method further comprises calculating a numerical value representing the modality of the true PSD, wherein the numerical value is calculated using the equation Z equals kurtosis minus the square of the skewness, wherein the kurtosis and the skewness are calculated for the true PSD; wherein the PSD and the true PSD are determined by a particle size analyzer.

BRIEF DESCRIPTION OF THE DRAWINGS

CLAIMS

What is claimed is:

1. A method comprising, for a particle size distribution (PSD) of a plurality of particles of a nonuniform solid phase material, wherein the PSD is for a group of particles having a volume percent equal to 100 vol%, removing a top volume percentage and a bottom volume percentage from PSD to obtain a true PSD; wherein the top volume percentage comprises the particles in at least the highest 0.5 vol% of the particles of the PSD and the bottom volume percentage comprises the particles in at least the lowest 2.5 vol% of the particles of the PSD;

wherein the method further comprises calculating a numerical value representing the modality of the true PSD, wherein the numerical value is calculated using the equation Z equals kurtosis minus the square of the skewness, wherein the kurtosis and the skewness are calculated for the true PSD;

wherein the PSD and the true PSD are determined by a particle size analyzer.

2. The method of claim 1 wherein the top volume percentage comprises the particles in at least the highest 0.25 vol% of the particles of the PSD and the bottom volume percentage comprises the particles in at least the lowest 2 vol% of the particles of the PSD.

3. The method of claim 1 or 2 wherein the particulate solid phase material has a PSD that is unimodal or bimodal.

4. The method of any one of the preceding claims wherein the particulate solid phase material comprises an inorganic material.

5. The method of any one of the preceding claims wherein the particulate solid phase material comprises a catalyst.

6. The method of any one of the preceding claims wherein the material comprises a catalytic material spray-dried on a particulate solid phase filler.

7. The method any one of the preceding claims further comprising selecting the particulate solid phase material for use in a manufacturing process for making a manufactured product, wherein the suitability of the particulate solid for use in the manufacturing process is based on the Z-factor.

8. The method of any one of the preceding claims wherein the Z-factor value of the particles is at least 2.7, or at least 2.8 or at least 2.9.

9. The method of claim 7 wherein the particulate solid comprises a Ziegler-Natta catalyst spray-dried on a particulate solid phase filler, the manufacturing process comprises polymerizing ethylene or copolymerizing ethylene and an alpha-olefin in the presence of the catalyst in a gas phase fluidized bed reactor.

10. The method of any one of the preceding claims wherein the particle size analyzer is an LS 13 320 Laser Diffraction Particle Size Analyzer, available from Beckman Coulter.