STT® Reactor Applications Areas

The STT® System

The STT® system is a combination of patented processes and equipment for the manufacture of chemicals, pharmaceuticals and energy products. Named the STT® system after it's spinning tube-in-tube design, the system's unique two-dimensional flowing film format produces significant time and cost savings over traditional production methods.

The STT® system allows our customers to avoid serious inefficiencies resulting from uneven mixing, temperature gradients, scale-up constraints, and excessive waste which are prevalent in most conventional manufacturing processes. With its broad applicability and flexibility, the STT® system allows acceleration of chemical reaction rates by up to three orders of magnitude, increase conversions and yields, control the quality of chemical processes in real-time, dramatically decrease cost, and decrease the time required for manufacturing scale-up.

The STT® process and equipment are covered by 15 patents and additional patents pending worldwide.

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Overview

STT® technology creates significant increases in reaction rates where momentum, heat or mass transfer are issues. The Applications Table on the reverse side provides a sampling of initial un-optimized reaction results when the STT® technology is applied in specific application areas. Comparative examples are provided that illustrate the difference between the performance of the STT® reactor and a batch process run under similar conditions.

Reaction rates, yield, and/or selectivity can be enhanced further when optimized reactor conditions have been empirically determined. A significant benefit of the STT® technology is that optimization can be determined on the bench scale (Magellan® series) which easily scales through the pilot production (Innovator® series) and then into the commercial scale.

Some of the advantages that the STT® reactor technology brings include:

- Rate enhancement
- Improved conversion
- Selectivity enhancement
- Reduced batch cycle time
- Improved temperature and reaction environment control
- Reduced catalyst consumption and solvent use
- Reaction of normally immiscible materials
- Mixing of materials with large relative viscosities
- Improved safety in handling toxic and explosive materials
- Rapid and efficient cleaning
- Small reactor foot print compared to conventional reactors

Other Applications

For those interested in more complex chemistry please request our Pharma, Agricultural and Specialty Chemical Applications Table for some examples of how the STT® reactor technology can benefit you.

STT® Reactor Application Areas

Type of Reaction	*Examples*
Chemical Synthesis	• Selective Oxidation – Rate and selectivity improvement that is reaction dependent. Depending on the goals, rate is sacrificed for selectivity to an intermediate oxidation product. • Selective Hydrogenation – Rate improvement with reduced catalyst use. • Esterification – Rate increases of up to 300x over typical batch reaction. • Transesterification – Similar to or better than Esterification • Saponification – Peanut oil to soap in 11 seconds, ~300x rate increase. • Hydrosilylation - Rate increases of 500x seem to be normal. • Condensation – 7x improvement in conversion over batch reaction.
Polymer Synthesis and Modification	• Polyesters – Rate improved similar to that seen for esterification. • Polyamides – Similar improvements expected as with Polyesters. • Polyolefins – 10x faster and at lower temperatures than in a batch reaction. • Polystyrene – Quantitative polymerization in 90 seconds. • Polyacrylates – 90+ % conversions in < 20 seconds. • Immiscible monomers processing. • Immiscible polymer alloy blending. • Depolymerization – recycling as an environmental benefit.
Solids synthesis	• Fine particle synthesis – Particle size control by Shear Rate and Residence Time (~3 seconds). • Sol gels – Technology is well suited for this application. • Also well suited for complex inorganic materials for high performance applications where uniform product with specific morphology is required.
Mixing Blending Compounding Emulsification Suspensions	• Rapid blending of components. • Improved mixing/blending of immiscible components. • Blending of high and low viscosity components. • Blending of additives/stabilizers into a polymer. • Rapid pH adjustment especially good for viscous solutions. • Blending of polymers to form alloy mixtures. • Emulsion stability improvement with lower emulsifier use.
Biocatalysts and Bioprocessing	• Use of enzymes or whole cells in synthesis – dispersing active materials to improve activity per unit volume with low shear rates (e.g. yeast fermentation of molasses decreased fermentation time by ~40%). • Anaerobic and aerobic synthesis. • Waste processing applications. • Lyse cells efficiently – utilizing high shear rates to lyse.
Extractions	• Natural product extractions into immiscible fluid phase. • Chemical purification – impurity removal. • Extract products from lysed cells. • Separation and distillation related applications being developed.