



STT® Technology Testing at US EPA Labs



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 its 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, reduce costs, and dramatically decrease the time required for manufacturing scale-up.

The STT® process and equipment are covered by 15 patents and several patents pending worldwide. STT, Magellan and Innovator are registered trademarks of Four Rivers BioEnergy Company, Inc., all rights reserved.

United States Environmental Protection Agency (US EPA) Cooperative Research and Development Agreement

For over 6 years, Four Rivers and the United States Environmental Protection Agency (US EPA) have been in collaboration to develop and commercialize green and sustainable chemistries for numerous chemical, pharmaceutical, food processing, flavor, fragrance and other applications using Four River's STT® technology.

In March 2003, the US EPA and Four Rivers entered into a Cooperative Research and Development Agreement (CRADA) to demonstrate the applicability of the STT® technology in green and sustainable chemistries. This licensing arrangement is structured as a research agreement operating under a government sponsored cooperative research and development agreement. Through the agreement, STT® equipment and know-how is provided to the US EPA Labs in Cincinnati, Ohio to demonstrate green chemistry applications and provide inexpensive testing services for corporations interested in doing bench-top or pilot scale green chemistry evaluations in the STT® system.



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STT[®] Technology Testing at US EPA Labs



An Innovator[®] 200 at the EPA Labs in Cincinnati, Ohio

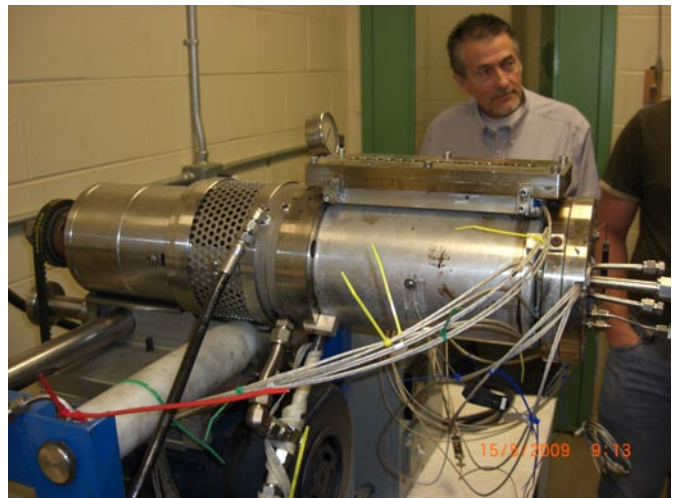
The EPA is currently utilizing two bench scale Magellan[®] STT[®] systems, one pilot scale Innovator[®] 200 STT[®] system, and the larger Innovator[®] 3000 STT[®] system at the National Risk Management Research Laboratory in Cincinnati, Ohio. The STT[®] research and trials are part of the EPA's Sustainable Chemistry Program and under the direction of Michael Gonzalez, Ph.D., Chief, Systems Analysis Branch Office of Research and Development Sustainable Technology Division and James Ciszewski, Ph.D. Dr. Gonzalez has found that the unique mixing pattern of the STT[®] system can dramatically improve reaction rates, conversions, product selectivity, yields and provide other advantages, while reducing energy consumption, under process intensified conditions. Drs. Gonzalez and Ciszewski have also performed research on commodity scale synthesis of ionic liquids and amines using the STT[®] reactor.

The US EPA labs in Cincinnati, Ohio also have excellent analytical capabilities to monitor the output from the STT[®] reactor (including NMR, GC, GC-MS, LC, LC-MS, IR and Uv-Vis). They also have extensive experience with the STT[®] reactors in optimizing reactions and conditions. (This experience is evident in the research and testing of ionic liquids which show extremely high conversions in the STT[®] reactor compared to conventional reactor systems.)

The EPA labs have worked with several major corporations and the work is usually performed under a 3-way mutual NDA between Four Rivers, the US EPA, and the customer so that what the customer learns is kept confidential.

Companies interested in innovation and application trials using Four River's STT[®] technology can do so through the US EPA laboratories for a very modest daily laboratory/testing fee. The equipment, staff and facilities all reside at the US EPA, as well as a variety of pumps, so testing can begin quickly. The EPA labs in Cincinnati, Ohio also have extensive analytical capabilities to be able to monitor the output from the STT[®] reactor (including NMR, GC, GC-MS, LC, LC-MS, IR and Uv-Vis).

The US EPA's daily rate of \$2000 USD includes the use of staff, facilities and analytical for testing and demonstration purposes



An Innovator[®] 3000 at the EPA Labs in Cincinnati, Ohio