

Effective Innovation: using the Theory of Inventive Problem Solving to develop improved wet-wall gas quenches

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Abstract

Rapid quench cooling of gas streams with sprays is critical to a number of applications including flue gas conditioning, incineration, acid gas processing, and pyrolysis gas processing. The art and science of such designs is scattered throughout the academic and patent literature. State of the art computational models and robust spray measurements enable optimization of the performance of a specific quench design. Selecting the most appropriate design is an engineering problem routinely solved by the experienced designer; however, due to design trade-offs, the shortcomings are often incompletely resolved.

Using systematic innovation tools, such as Theory of Inventive Problem Solving (TIPS), can transform the design process by reducing complexity to the lowest level while achieving robust results. This method, known by the Russian acronym TRIZ, enables rapid development and exploration of innovative design space. The application of several key concepts and methods, including ideality, function analysis, substance field analysis, and innovation algorithm, are illustrated by a wet-wall industrial scale spray quench design. Two of the tools are emphasized and the results compared with existing patents. Describing the fundamental issues with a function diagram showing useful and harmful actions incorporates the most complete knowledge of the situation. A substance-field diagram showing the interaction of substances and fields (energy) narrows the innovative focus to the design conflict zone. With the abstract description of the problem refined, a systematic search for innovative solutions is used. These descriptions retain the essence of the problem without jumping to solutions. An algorithmic approach to inventive design is at least an order of magnitude more effective than the ubiquitous brainstorming. TIPS methodology is a practical means of understanding complex innovative problems and focusing the inventive efforts on the root problem.

Key words: