

**INTEGRATED INHERENT SAFETY INDEX (I2SI): A COMPLETE TOOL FOR
INHERENT SAFETY EVALUATION**

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ABSTRACT

Inherent safety is a proactive approach for risk management. Many studies in the past have confirmed that inherent safety is a cost-optimal option considering the lifetime costs of a process and its operation. Inherent safety can be incorporated at any stage of design and operation; however, its application at the earliest possible stages of process design (such as process selection and conceptual design) yields the best results. To fully exploit the benefits of inherent safety, the designer/process engineer requires an inherent safety evaluation tool applicable to their situation. In a recent AIChE publication, *Making EHS an Integral Part of Process Design*, inherent safety has been identified as having a primary focus on process safety with a secondary focus on health and directly linked benefits to the environment. Inherent safety thus plays a key role in integrating environment, health and safety considerations throughout process design.

There have been several efforts made by different agencies to develop inherent safety evaluation tools. Examples include the INSET tool kit sponsored by the European Community, the overall inherent safety index prototype proposed by Edwards and coworkers at Loughborough University, UK, the inherent safety index proposed by Heikkila and co workers at VVT, Finland, and the fuzzy-based inherent safety index proposed by Gentile and coworkers at Texas A&M University, USA, by Palaniappan and coworkers at National university of Singapore, Singapore, and by Shah and coworkers at Swiss Federal Institute of Technology, Switzerland. In addition to these tools there are several programs or methods that have been adopted within different corporations to evaluate the potential for inherent safety considerations in design and operation. Examples include the Rohm and Haas major accident prevention program, Exxon Chemical's inherent safety review process at various points in the process life cycle, Union Carbide's index based system for inherent safety reviews, and the software tool developed by Sandoz to assist chemists and engineers in identifying hazards and inherently safer process options. There remains, however, the need for a systematic and easy to use tool that may answer most of the safety design questions.

This paper will present details of an integrated inherent safety index (I2SI). The conceptual framework of this index was presented in 37th Annual AIChE's LPS conference (March 31-April 2, 2003) and to be published in coming issue of *Process Safety Progress*. In addition to the framework, this paper will discuss additional features of the index such as cost model and system design model, which were not presented or discussed earlier. It is called an *integrated index* because the procedure considers the life cycle of the process with economic evaluation and hazard potential identification for each option. I2SI is comprised of three subindices, which account for hazard potential, inherent safety potential, and add-on control requirements. In addition to evaluating these respective characteristics, the subindices also measure the economic potential of the option. Finally, these subindices are grouped to give two numbers, one to denote the inherent safety potential of the option and the second to signify economic potential. An application of the I2SI will also be discussed in the paper.