

## The APPI Evaluation Committee has issued recommendations to 8 project briefs in first round of the tender procedure - second round open for all applicants

- **8 project proposals** have received recommendations from the APPI Evaluation Committee in the first round
- **The second round of the call is also open for project proposals that did not participate in the first round**
- Visit <http://dsti.nl/appi> for detailed information and templates
- **Submit full project proposals by December 18, 2009 (17:00 hrs)**
- Use the **"consortia matchmaking service"** of the Taskforce APPI

The Action Plan Process Intensification (APPI) aims to accelerate the implementation of process intensification in the Dutch process industry. The plan includes a research program of eleven program lines. The call of the first phase of the Action Plan concerns three program lines, for a total of EUR 13.5 m over a period of five years: Alternative energy-based operations, Transport-limited processes, PI process analysis tools.

In the first round of the Action Plan Process Intensification's call for project proposals, 8 project proposals were received with a combined budget of EUR 22 million – the available total budget is EUR 13,5 million. These proposals have received a recommendation from the APPI evaluation Committee how to (further) optimize the proposal into a "full proposal" that will be submitted in the second round, with the deadline of December 18, 2009 (17.00 hrs). Project proposals that have not participated in the first round are still welcome in the second round, although they will not benefit from the recommendations of the Evaluation Committee. The following general recommendations were issued to all project briefs:

Evaluation criteria    Recommendation

Innovativeness    •    Demonstrate the potential to improve the state-of-the-art, through international literature reference

•    Focus on a well defined, limited, achievable innovation

R&D value chain planning    •    Try to accelerate projects, e.g. through concurrent activity planning

•    Demonstrate that the project planning and objectives are realistic – assess chance of success

Prospective commercial valorization    •    Quantify the potential economic value: estimate the application potential (volume, EUR) in The Netherlands (and worldwide). Indicate / estimate / quantify the potential PI benefits (in reduced energy consumption, waste, safety, ...)

The Taskforce APPI offers a **"consortia matchmaking service"** to organizations that want to join existing project consortia: please express your interest to the Taskforce APPI

(via an e-mail to [appi@dsti.nl](mailto:appi@dsti.nl)) and we will inform the project consortia of your interest. The following project coordinators have asked us to communicate their project summary to you, so that you can contact them directly to discuss possible participation in their project consortium:

**Project: Demonstration of a continuous reactor with in-line analytics for fine chemical production**

**Project coordinator:**

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**Project summary:**

The research proposal aims for demonstrating one multi-purpose micro-structured reactor, one multi-phase flow tubular reactor and a compatible PAT technology at industrial conditions within a period of three years. Proposed is a two-step approach consisting of benchmarking and of piloting. First, a systematic benchmark of several micro-reactors and tubular milli-reactors for industrially relevant reactions will be performed including the implementation of a (novel) in-line PAT tool, preferably suitable for multiphase flow. Secondly, after selecting the most promising reactors will be demonstrated on site under industrial conditions. The size of the demonstration unit is expected to be able to produce 100-

1000 kg/hr of product. Next to the hardware, robust methods for model predictive process control will be developed and tested.

**Project: New Generation of Internals and Heat Exchange Integration Methods for High-Gravity Process Intensification Equipment (INTEGRA)**

**Project coordinator:**

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**Project summary:**

Chemical processing in High-Gravity Rotating Packed Beds presents one of the most interesting Process Intensification technologies in multiphase systems. According to the recent Technology Report written for the European Roadmap for Process Intensification, Rotating Packed Beds have already been applied on the commercial scale in at least 11 processes in China and the U.S. The applications range from (reactive) stripping to manufacturing of nano-particulate products.

Despite a growing number of applications, the Rotating Packed Bed technology has attracted so far only limited interest in the Netherlands and in Europe. Furthermore, no (catalytic) reaction applications of the RPB's have been realized so far.

The current project focuses on the development of the new types of internals and new heat management methods for the Rotating Packed Bed devices. New types of internals are needed, in order to broaden the application potential of the RPB's towards the catalytic reactions and reactive separations. On the other hand, innovative heat management methods in RPB's will be developed, to allow carrying out fast, highly exothermic or endothermic reactive processes.

### **Project: Development of Industrial Continuous Oscillatory Flow Reactors and Crystallizers Operating with Alternative Energy Fields (OSCALT)**

#### **Project coordinator:**

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#### **Project summary:**

Alternative energy forms, such as microwaves or ultrasound, have been shown to intensify chemical operations by shortening the reaction times from hours to minutes or seconds, improving the process selectivity or product quality/properties.

In the present project alternative energy fields will be investigated in conjunction with the Continuous Oscillatory Flow technology. That technology, nowadays commercialized by e.g. NiTech Solutions, allows for a near-plug flow operation at low overall flow velocities, thus long reaction times, by changing a pipe into a large number of stirred-tanks in-series. The oscillatory baffled flow concept increases residence time and ensures intensive mixing. It is robust and can be applied at a very wide range of production capacities from small pharmaceutical scales up to the large scales of bulk chemical products. The inherent features of the Continuous Oscillatory Flow technology make it a perfect mean to fully utilize the unique advantages of the microwave and ultrasound fields in a spatial sense on industrial scale, at the same time eliminating most of their operational drawbacks.

Accordingly, the aim of the project is to develop new concepts of oscillatory flow reactors and crystallizers operating with the assistance of electromagnetic (microwave) and acoustic (ultrasound) energy fields and scale them up to the scales that are relevant for 1) the fine chemical and pharmaceutical industry (100-1000 ton/y), 2) polymer industry (1.000-100.000 ton/y) and 3) the biofuels industry.

The research will cover the limiting engineering issues by considering the modeling and control of such reactors and crystallizers in combination with a clever and innovative design based upon the physical principles of microwaves and ultrasound. Such a bottom-up approach from fundamentals to engineering is the best guarantee for the design of truly intensified devices. The ultimate goal is to remove heat and mass transfer limitations as well as hydrodynamic restrictions, thus stripping the process down to its intrinsic kinetic limitations, in order to take full advantage of the inherent features of microwaves and ultrasound. Additionally, in crystallization the full control upon the individual elementary tasks (nucleation, growth, etc.) will be sought

by applying alternative energy forms in pre-defined locations. In this way these crystallization tasks can be separated and confined within certain spatial and temporal domains, to achieve optimal conditions for the required product properties and quality.

The project will be realized in five interconnected work packages, each related to the given

product category and the given type of operation. Accordingly, five technology concepts (reactors for fine-chemicals/pharmaceuticals – polymers – biofuels and crystallizers for fine-chemicals/pharmaceuticals – bulk chemicals) demonstrated at the pilot scale will be the final delivery of this project.

The Dutch Separation Technology Institute (DSTI) functions as the legal and administrative entity for the execution of the Action Plan Process Intensification. DSTI's process intensification component was detailed in cooperation with the Energy Transition Platform Chain Efficiency. The program's execution is enabled by a subsidy from the Ministry of Economic Affairs' Innovation Agenda Energy.