ISGC 2022

N°777 / OC
TOPIC(s) : Alternative technologies / Chemical engineering

Beads Impact Continuous Heated Mechanochemical Reactor for Greener Chemical Routes

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PURPOSE OF THE ABSTRACT

The new IMPAºCT REACTOR, patented by Deasyl SA, unify for the first time the benefits from mechanical energy, thermal and pressure activations in continuous flow. The synergy obtained makes of this novel technology an advanced solution providing an unprecedented efficiency in the synthesis of high value-added chemicals as:
- the mechanical energy generated by micro-beads will overcome energy barriers and mass transport limitation necessary to induce a large variety of chemical processes;
- the incorporation of an in-situ induction heating system will allow an accurate control of temperature, going beyond the uncertainties of usual hot spots in conventional ball milling, giving rise to non-homogeneous results unsuitable for industrial implementation;
- the possibility of using simultaneously solids, liquids and incorporating gases, with pressure control in the reactor provides high potential and versatility to the prototype, opening its application to many different processes and many chemical industry fields;
- the continuous flow processes display significant advantages.

This unique technological concept will provide the chemical/pharmaceutical industries with a new, sustainable, energy saving, versatile and scalable alternative to currently available synthesis technologies as it will: (i) shorten reaction times (from hours to minutes) as result of the synergistic effect of simultaneous activation by mechanical energy, heating and pressure; (ii) decrease the reaction temperature; (iii) improve reaction kinetics as mass transfer limitations are reduced and the collision between beads and reactants increases the contact between them; (iv) minimize the use of solvents and reagents; (v) decrease the number of reaction steps, since one-pot reactions become possible; (vi) increase volume treated (from mL to L), enabling a real scale-up; (vii) obtain new phases, which is impossible, using conventional processes; (viii) renew catalytic sites on catalyst surface and (ix) enhance the yields and/or selectivity, as regeneration of catalyst surface takes place simultaneously to the reaction.
As proof of concept of the possibilities to use this technology for intensification of processes made by this, some organic and inorganic synthesis processes are developed and adapted to the IMPA°CT Reactor in the context of biomass, and particularly glycerol valorization. Among them figure the synthesis of heterogeneous catalysts and the synthesis of solketal [1,2].
This novel technology for continuous flow and with up-scale possibilities could be extended to various relevant molecules and catalytic processes including dehydrations, selective hydrogenations, amidations, aminations and alkylations among others. The IMPAºCT REACTOR can have a decisive transforming effect in the EU chemical industry opening new opportunities for greener, more sustainable, energy saving, and efficient chemical

processes as proposed by European Green Deal challenges.

FIGURES

FIGURE 1
IMPA?CT Reactor
IMPA°CT Reactor

FIGURE 2

KEYWORDS
Green Chemistry | Mechanochemistry | Continuous flow | Induction heating

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