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To cite this version:

Christine Frances, Nadine Le Bolay. Special issue on innovative processes and materials. Powder Technology, 2014, 255, pp.1-2. 10.1016/j.powtec.2014.01.066 . hal-01894042

HAL Id: hal-01894042

https://hal.science/hal-01894042v1

Submitted on 12 Oct 2018

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To cite this version:

Frances, Christine and Le Bolay, Nadine *Special issue on innovative processes and materials.* (2014) Powder Technology, 255. 1-2. ISSN 0032-5910

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Editorial

Special issue on innovative processes and materials

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Innovation in particulate processes is a challenging task in many industrial applications, such as for drug formulations, paints, coatings, ceramics and green products. This special issue, whose idea came from a French workshop, does not have the ambition to raise an exhaustive state of innovation in powder technology. Focusing on some examples of works performed in this domain, it aims to show that innovation can take several facets. It can be oriented either on the material, creating new products having creative properties or on the process itself, based on new routes for product synthesis or on conventional processes but used in non-conventional conditions. This special issue gathers 20 of the nearly 120 papers presented at the French Symposium on Particulate Processes which was held in Toulouse from the 4th to 6th of July, 2012. This congress was the 7th of a conference series aiming to bring together researches from industry and academia to debate the latest developments in particulate processing.

The first group of papers mainly involves particulate processes where the focus is on examining the synthesis conditions or process routes on achieving innovative materials such as composite materials having desired properties in relation with their application. A major sub-group is focused on biomaterials either to produce innovative materials for biological applications or to use bio-waste materials to produce new materials. In paper [1], the preparation of peroxide-doped calcium phosphate apatites used as bioactive bio-ceramics was investigated. The production of new materials on the base of bio-waste materials and biodegradable matrix is described by Koutsomitopoulou et al. [2]. The next two papers [3] and [4] also concern bio-materials based on apatites for therapeutics or diagnosis purposes [3] or for the production of coatings [4]. The following papers [5–11] concern composite or functionalized materials for a wide spectrum of applications. Thus, the work of Champion et al. [5] is focused on the development of a dense fissile material, made of γ-U[Mo] particles embedded in an Al based matrix. The two next papers concern composite materials, made of a polymer-organic compound (mixtures of polyvinyl acetate and starch) in Ref. [6] and an organic-mineral cement (formulation of a drug-based bone substitute) in Ref. [7]. An example of the shaping process is then given in paper [8] reporting the effect of compression on the structural and catalytic properties of metal-organic frameworks. In the following paper, Kenouche et al. [9] analyze functionalized magnetic nanoparticles for a potential application as contrast agents in nuclear magnetic resonance imaging. An application of composite synthesis in food is then reported in Ref. [10]. And finally, another kind of composite material is described in Ref. [11] where porous extrudates were obtained based on the packing of multi-sized alumina particles and boehmite or aluminophosphate binders.

A second group of papers [12–18] focuses on the analysis of innova-tive processes used to produce powders with the desired properties. In the first paper, the work is focused on the CO_2-induced precipitation of a drug in order to improve its bioavailability [12]. Wet nanogrinding process, as a route to produce nanoparticles in dense suspensions using a stirred media mill, is then described in the next paper [13]. Then, papers [14] and [18] both concern crystallization processes but with two different strategies. Melt crystallization as a purification route respectful of environmental constraints is examined in reference [14] and a crystallization process performed in a continuous reactor for synthesis purpose is presented in paper [18]. Spray-drying is the process used in both papers [15] and [16] but for two different purposes. In reference [15], the spray drying of oil-in water emulsions, containing hydrophilic carriers, is used to encapsulate lipophilic compounds into powders while in paper [16], spray drying is performed to produce chitosan–hydrophobic silica composite microspheres. A complementary analysis is reported on a pneumatic drying process [17].

Moreover, the development of new processes and materials may have an impact on societal and environmental issues and these potential drawbacks must be properly evaluated and solutions must be developed to overcome them. The last two papers of this special issue concern the emission of fine or ultrafine particles in air [19] or water [20]. In paper [19], a characterization test of dust generation is developed, whereas the last paper presents a review of the risks associated to the release of nanoparticles into the aquatic environment and lists some techniques for remediation.

Obviously, new developments in particulate processes are only possible thanks to innovative characterization methods and methodologies. Thus, the reported works in this special issue are mainly based on the use of recent characterization techniques such as NMR, X-Ray diffraction, Transmission Electron Microscopy, FTIR spectroscopy and Raman spectroscopy or include the development of specific methodologies based on rheological characterization or dynamic vapor sorption measurements.

We would like to thank the editor-in-chief of Powder Technology, Prof. Jonathan Seville, for his support in publishing this special issue and the editorial office of Powder technology for their help and guidance. As the guest editors, we also would like to thank the authors for their contributions and the panel of the international reviewers for their time and efforts in evaluating these papers and hard work towards the successful publication of this special issue.

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