

Conference Report

19th International Drying Symposium (IDS 2014) Lyon, France August 24-27, 2014

After the memorable 6th International Drying Symposium in Versailles in 1988, 26 years later, France, for the second time, had the honor and privilege to host another IDS. The 19th symposium of the series, IDS 2014, was held from August 24-27, 2014 at the Palais des Congrès of the Cité Internationale of Lyon, in the capital of Rhone-Alpes region, which is the second largest economic region and represents some of the largest academic research centers in France.

IDS 2014 attracted some 330 participants from 25 countries of 5 continents, mostly from the Northern Hemisphere. The origins of the selected full papers based on the nationality of the corresponding author, which corresponds generally to the country where the presented work was carried out, is shown in Table 1.

Table 1. Geographical distribution of participants

	Country	Paper Number
1	Brazil	56
2	France	29
3	Germany	29
4	Poland	27
5	China	25
5	Japan	17
6	Tunisia	16
7	Denmark + Netherlands	14
8	Turkey	13
9	Scandinavia	13
10	Spain + Italy	12
11	Mexico + Chile	12
12	Belgium	11
13	USA + UK + Canada	11
14	Algérie	10
15	Thailand+ Malaysia	9

16	India	9
17	Australia	8
18	Others	15
TOTAL		336

The large participation of Brazil, which came ahead even of the organizing country, has to be noted. After Brazil, one may note the significant participation from most of the European or Asian developed (Germany, France, Poland, Japan, Australia, Netherlands, Scandinavia, etc.) or Asian fast developing countries (China, India, Thailand, etc.) but also with significant participants from North Africa (Tunisia, Algeria), or other developing countries (Mexico, etc.). On the other hand, the low participation of USA, UK and Canada is noteworthy.

One of the main objectives of the organizers was to try to increase industry participation with a focus on problems of modeling and optimization of industrial dryers, with presentations and discussion on energy savings and environmental issues. Although most of the participants came from universities and government research centers (54%), we observed a significantly increased participation from industries: around 60 participants, representing about 17% of the total participants. Furthermore, a large part of IDS 2014 participants were young people – with 87 Ph.D. students, representing 29% of the attendance. This number was probably due to the special effort of the organizer to offer them significantly reduced registration fee.

The scientific program comprised of a number of oral presentations devoted to topics representing important challenges to the scientific community due to the important changes that affect rapidly and deeply the economy of our societies (energy transition, climate changes and renewable energy issues). The drying process corresponds to a large part of the energy consumed in the industry, so our discipline should be more and more concerned by these rapid changes, which already affect many manufacturing sectors in developed or in fast developing countries.

The organizers received about 470 abstracts. After the first step of the review process, realized with the efficient help of our international scientific committee (45 members), 360 of the submitted abstracts have led to full papers relevant to IDS themes. Finally, at the end of the selection process, only 320 revised full papers were retained in the final program. These comprised 6 keynotes lectures, 152 oral communications and roughly the same number of poster presentations. Only posters with selected and revised full text have been maintained in the final program and the corresponding full text has been included in the Symposium Proceedings (CD-ROM).

All presentations were classified into 8 categories. Two special drying processes, freeze-drying and spray drying, had sufficient number of papers to justify the whole sessions. As is usual in any drying conferences, drying of food and biological products remains very

popular with two large sessions (process kinetics and product quality), consisting of 2 keynote lectures, 50 oral presentations and 67 posters; this accounted for one third of the Symposium. The drying of pharmaceutical products secured one session.

The remaining sessions mixed different types of materials (foods, minerals, sludges, pharmaceuticals, biological products) and various types of drying technologies. The contributions in these sessions ranged from the fundamental aspects to industrial applications. As the oral/poster choice was made on the basis of the scientific reviews, the sessions with more oral than poster presentation may be emphasized: modeling and simulation, industrial processes, energy efficiency, freeze drying and spray drying.

Regarding the scientific content of the Symposium, an objective analysis is not easy. Nevertheless, we went through most of the papers to propose the following analysis.

Hot Topics

Among the "hot topics" we were quite impressed by the significant progress made in the simulation of multi-scale configuration, namely, for particle drying (either in spray drying or in moving beds). CFD and particle tracking (Lagrangian approach, DEM) are now able to deal with the full coupling between various transport processes. Imaging and more particularly 3-D imaging possibilities offered by CT-scanning became very usual tools to analyze drying and dried product quality. These two trends are indeed the subjects of recent review papers published in *Drying Technology*. Besides, many works were devoted to novel drying technologies, which allow intensification of the drying process or improvement of the dried product quality. To achieve this goal, hybrid systems are proposed, usually employing different energy fields or technologies (ultrasounds, electricity, IR, MW, osmotic dehydration, etc.) in addition to moist air convection. Pulsed fields or pulsed drying conditions are also becoming more current along with appropriate pretreatments prior to drying.

Papers devoted to relationships between process and quality continue to be abundant. However, the new trend is certainly to deal with the two-way coupling between product properties and the drying process. The drying process itself often changes the product structure, which in turn changes the drying behavior. This trend is certainly driven by the possibilities offered by modern experimental and modeling tools. Another 'hot subject' is related to biological concerns (preservation of molecules of interest, probiotics, vitamins, enzymes, viability during and after drying).

Regarding sustainable development, a worldwide 'hot subject,' real mushrooming could have been expected. However, one has to acknowledge that this was not the case yet at this event, in spite of a certain number of works in solar drying and superheated-steam drying.

Classical Drying Topics

Among classical works on drying, several studies were devoted to product characterization such as isotherms determination and drying kinetics measurement, as well as simple, if not simplistic, models. In this sense, it would be nice if the drying

community would be more aware of the drastic simplifications done for the analytical solution of Fick's law. Among the more severe assumptions lies the need to remove the equation energy (that excludes any coupling between heat and mass transfer), to assume constant diffusivity and geometry and to assume that the product surface attains the equilibrium moisture content as soon as drying starts.

Study of product quality via the use of phase diagrams, which include the concept of glass transition and stickiness, among others, is now well established and provides an efficient tool to optimize the drying process, especially when the product quality is of concern.

Among the classical topics, one has to note that some fields of interest clearly decrease: wood, paper and building materials. This may result from different reasons or a combination of reasons:

- The field was mature enough for the need to study vanished;
- Lack of available funding for these topics;
- Scientists involved in these fields shifted to other topics with a stronger demand (for example, several scientists involved in wood drying are now working on biomass as a source of energy).

Expected but Missing Topics

By looking at what happens worldwide in sciences and in our societies, new fields of investigation could have been expected. Yet these fields were not so common at this IDS. Sustainable development is of particular concern. As previously stated, quite low number of works was devoted to energy savings, use of sustainable energy or exergetic issues. The same absence, or quasi-absence, was observed for nano-structured materials and nano-structure formation during drying.

In the increasingly important biological field, one notes a huge increase in the presented works. Yet, the inclusion of biological models in drying models is still to come. Such multi-physics modeling could indeed be an excellent tool to consider the interaction between the drying process and, for example, cell viability. In the same spirit, molecular dynamics is becoming a powerful means to look at macromolecular behaviour: why not using its possibilities to look at biological behavior during drying?

On the other side of the R&D line, one would have expected more advances in the on-line control of dryers based on a mixture of non-invasive instrumentation and modeling to arrive at the models capable of forward control-loop.

Some Open questions for the Future

At the end of such a large event devoted to the field of drying, it is relevant to look forward and try to inspire future researches. At first, no doubt now that modeling and simulation will be more and more relevant in the future. Simulation software is so powerful now that we could expect them to give closer and closer results to what is happening at real industrial plants. Therefore, we have to focus on the ultimate goal of a

model in R&D: to improve existing processes, to help control of existing plants and to imagine new design and new processes. To archive this goal, at least three fields of investigations are needed:

- Use the increasing power of computer to deal with the variability and complexity of a material, e.g., namely, biomaterial,
- Produce database of product properties. In this sense, our community could propose a "standardized" way of presenting the results.
- Scientific community has still to work on the fundamental aspects (formulation and resolution) in order to be able to pick up the best compromise between the model complexity, its required computational time, level of knowledge of the material and final aim of the simulation.

IDS 2014 Awards

Several awards were given at IDS2014 to distinguished researchers who have devoted their career to drying. A summary of the awards and their recipients as well as award presenters is given in Table 2.

Table 2. List of IDS 2014 Awards, recipients and presenters

Award	Recipient	Presenter
Excellence in Drying Research	Patrick PERRE	Julien ANDRIEU
Excellence in Drying Pharmaceuticals and Biologicals	Severine VESSOT	Pascal VACUS
Excellence in Drying Award	Sakamon DEVAHASTIN	Patrick PERRE
IDS Founder's Award 2014 co- sponsored by Taylor & Francis	Xiao Dong CHEN	Arun MUJUMDAR
NESTLE Award	to be chosen during the congress	Alessandro GIANFRANCESCO

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