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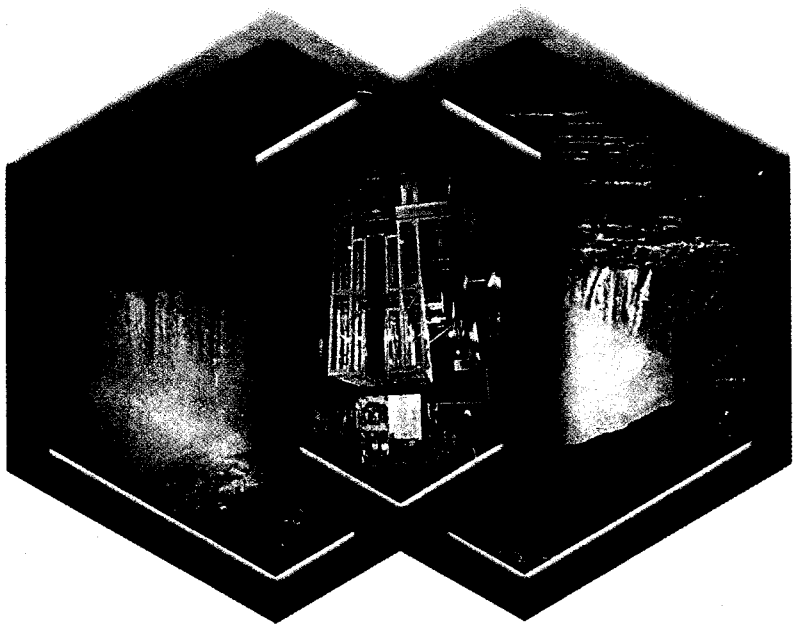

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Table of Contents / Table des matières

241 17:00 Monday POST2 HCC Chedoke A

Small Capacity Ecological Dryers for Biological Materials **T.M. Radivoj** <*r.topic@eunet.yu*>, Faculty of Mechanical Engeneering, University of Belgrade, Yugoslavia,27.Mart 80.

In this paper an original solution of a convection chamber small capacity dryer with compulsory flow of the drying agent based on electrical energy as the source of energy is given. It is used for drying small amounts of fruit and vegetables for the needs of town households and is the result of an analysis of existing methods and solutions for drying and possible methods of process intensification. The dryer solution is presented through a description of the concept, selection and definition of the concept and basic components of the solution. The dryer is transportable, with small dimensions and is characterized by a drying chamber of a cylindrical shape containing a number of vertically arranged pans for drying. Due to the dryer modularity the drying capacity can be changed. An appropriate construction of the drying chamber enables more uniform heating of the material by volume, which means more uniform extraction of water from the material. Experimental and analytical curves of the drying kinetics defined based on results obtained from drying experiments are given in this paper. It also contains results of a parallel analysis of the new dryer solution and existing ones, from the aspect of process intensity, energy saving, quality of the dried materials and protection of the environment.

244 17:00 Monday POST2 HCC Chedoke A

Advanced Control of Paste Drying in Spouted Bed: Industrial Trials **N.A. Corrêa** <*nacorrea@iris.ufscar.br*>, Department of Hydraulics and Sanitation, SHS, EESC, Universidade de São Paulo, CP:359, CEP: 13560-970, São Carlos, SP. Brazil; **F.B. Freire** <*fabio@iris.ufscar.br*>, **R.G. Corrêa** <*ronaldo@power.ufscar.br*> and **J.T. Freire** <*freire@power.ufscar.br*>, Department of Chemical Engineering, DEQ, Universidade Federal de São Carlos, CP:676, CEP: 13565-905, São Carlos, SP. Brazil.

The work consists in implementing an advanced control strategy (QDMC - Quadratic Dynamic Matrix Control) in order to turn into automatic and improved operation in a large-scale spouted bed dryer. The motivation came from results found in works with a laboratory apparatus (see Drying Tech. J. Vol. 20, No 4, pp. 813-828, 2002). The industrial spouted bed dryer is 4 m in height and 0.66 m in diameter. An instrumentation with sensors, final control elements and interface is based on that developed for the laboratory unit. The equipment is able to process up to 20 L/h of pasty material. The powder moisture content, estimated from the bed temperature, and the powder production rate that is measured on line by an electronic balance, are the controlled variables. The manipulated variables are: the paste feed rate, regulated by an automatic pump, and the electrical power supply for air heating, regulated by a thyristor. Other process input/output signals (like the bed pressure drop, the air flow rate, and some environmental conditions) are interfaced by means of a microcomputer. Tests with drying up to 400Kg/day of Al_2O_3 10% aqueous suspension were accomplished. A robust QDMC control was obtained and the main operational constraints were obeyed. The major problem concerning the scale-up, to balance the energy demand with the spout stability, was overcome with the constrained control.

242 17:00 Monday POST2 HCC Chedoke A

Fry-Drying of Sewage Sludge : Preliminary Experiments **D. Pires da Silva** and **O.P. Taranto**, FEQ/UNICAMP, Faculty of Chemical Engineering - State University of Campinas, Cidade Universitária Zerefino Vaz, CP 6066, 13084-970, Campinas, São Paulo, Brazil; **C. Peregrina Cambero**, **P. Arlabosse** and **D. Lecomte** <*lecomte@enstimac.fr*>, Laboratoire de Génie des Procédés des Solides Divisés (UMR 2392), Centre Energétique Environnement, Ecole des Mines d'Albi Carmaux, Route de Teillet, 81013 Albi CT Cedex 09 France; **V. Rudolph**, Department of Chemical Engineering, University of Queensland, St Lucia QLD 4072, Australia.

Sewage sludge is a by-product of treatment of wastewater. It represents a significant problem in terms of its volume and of its complex composition, especially when regarding the sludge final disposition. Sewage sludge is commonly applied to agriculture, used as a co-fuel for energy saving inside the wastewater plants, or even only disposed to landfills. Whatever disposal route chosen, drying of the sludge is an essential step. Most of sludge dryers are issued from standard equipment but adaptation of existing technologies is not straightforward. In this work, drying of sewage sludge was carried out using an alternative method - immersion frying - which is one of the most common operations in food industry. Fry-drying of sewage sludge was performed at the laboratory as a drying process. Water loss during frying was quantified and the drying rates curves were obtained for different oil temperatures. Analogies between the drying periods and the frying periods were done, permitting the study of the types of moisture present in the sludge matrix. The curves obtained indicate that diffusion transfer mainly dominates the drying process. Photographs taken from the fried material at certain frying time allowed the visualisation of the crust and its increase during frying. All these results will be presented in the final paper.

245 17:00 Monday POST2 HCC Chedoke A

Integration of Alternative Energy Sources into Municipal Heat Supply Systems **A.K. Kuzin** <*akousine@mail.ru*>, **P. Kapustenko** <*kap@kpi.kharkov.ua*> and **L.M. Ulyev** <*ulm@kpi.kharkov.ua*>, East-Ukrainian Association of Enterprises in the branch of Ecologically safe Energetic and Energy saving (EEE).

Possibilities for integration of solar systems for heat and hot water supply into existing municipal heat supply systems in towns/cities of middle latitudes are based in the work. It is shown that is much more profitable to use heat of municipal boiler houses as a doubler than use of electric pre-heating (used now) and to integrate solar heat supply systems with the help of individual heat points. Main factors that hamper wide use of renewable energy sources for heat and hot water supply are analyzed.
The first one - thermal energy producers. "Teplokommunenergo" companies are monopolists in Ukraine. And it is unlikely that they would produce thermal energy using renewable sources. So they will do everything possible to put obstacles in the way on alternative energy sources (AES) introduction.
The second one - lack of legislative support for energy producers using AES. It is clear that if push aside this obstacle than the first one will be also pushed aside. That is why interested groups of people should press on all authorities (local, state, etc.) for passing laws on support of energy producers using AES.
The third one - last but not least - lack of technical solutions, in particular for solar heat supply system, lack of technological schemes applicable for potential consumers.
Works are performed under support of EC (Tempus-Tacis project CD_JEP-21242-2000).

243 17:00 Monday POST2 HCC Chedoke A

Quality and Energy Aspects of Convective and Microwave Drying **J.S. Kowalski** <*kowal@rose.man.poznan.pl*>, Poznan University of Technology, Institute of Technology and Chemical Engineering, Marii Sklodowskiej-Curie 2, Poznan, Poland, ; **A. Rybicki** <*rybicki.andrzej@put.poznan.pl*> and **K. Rajewska** <*rajewska.kinga@put.poznan.pl*>, Poznan University of Technology, Institute of Technology and Chemical Engineering, Marii Sklodowskiej-Curie 2, Poznan, Poland.
Drying of capillary-porous materials by convective and microwave methods has been investigated theoretically and experimentally to estimate the unit energy consumption, and to evaluate the tendency to generate mechanical stresses in dried materials.The mechanistic model of drying, taking into account the coupling effects between the temperature field, the moisture content field, and the stress field made the basis for the theo-retical analysis of the problem. Because of volumetric heat generation, the material temperature in microwave drying is higher than the ambient temperature, so the gradients of temperature and moisture content co-incide. It denotes that the diffusional and thermodiffusional flows of moisture proceed in the same direction. This is not the case of convective drying, where the thermodiffusional effect hinders the outflow of the moisture from the material being dried. Such an effect poses greater non-uniformity in the moisture distribution, and consequently generates greater stresses.
The experimental investigation consisted in measurements of energy for removing a unit mass of moisture, and monitoring destruction of the material dried by these two methods. The monitoring was carried out on line, using the acoustic emission method. A sort of kaolin was taken as the sample material.
Finally, some prevalence of the microwave drying over the convective drying was stated, as far as product quality and unit energy consumption are concerned. Because microwave technique is much more sophisticated, its application to industrial processes may pose some difficulties.

246 17:00 Monday POST2 HCC Chedoke A

Optimal Drying Process with Respect to Material Strength and Drying Time **J.S. Kowalski** <*kowal@rose.man.poznan.pl*>, Poznan University of Technology, Institute of Technology and Chemical Engineering, Marii Sklodowskiej-Curie 2, Poznan, Poland, ; **A. Rybicki** <*rybicki.andrzej@put.poznan.pl*>, Poznan University of Technology, Institute of Technology and Chemical Engineering, Marii Sklodowskiej-Curie 2, Poznan, Poland.

One of avenues to avoid cracking caused by material shrinking is to slow down the drying process though it extends drying time. We claim that it is possible to design the optimized drying processes to be relatively fast and safe as far as the strength of the material is concerned. Optimized drying processes require a continuous control of the drying parameters and their suitable variation in the course of drying.
This paper presents virtual, computer simulated, drying processes based on the mechanis-tic model of drying. Here, the stress in the hypothetical dried material is controlled continu-ously, and when it reaches a critical value, the drying parameters are changed to slow down the drying. Slowing down the process levels the moisture content distribution, which reduces the stresses. Then the processes can be accelerated and slowed again, if needed.
An important issue is selection of the temperature and the humidity of the drying medium. We can justify that processes carried out at higher temperatures and humidities proceed faster and are more save from the material strength point of view than the processes at low drying medium humidity.
On line control of the stress in real materials is possible when using the acoustic emission method. An enhanced emission of acoustic signals and the emitted energy caused by fractures in dried material may indicate a critical state of the stresses. At that moment the drying pa-rameters ought to be changed to slow down the process.