



HEAT PIPE-SCREW DRYER: A NOVEL DRYING TECHNIQUE

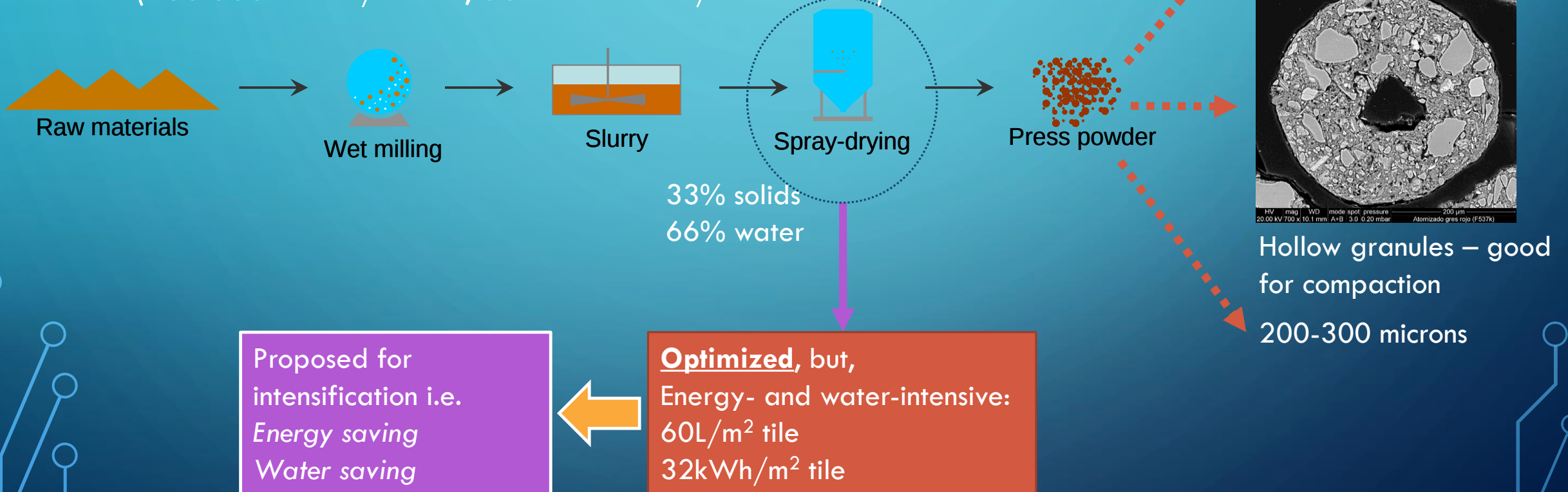
INTENSIFIED-BY-DESIGN (IBD) – EU HORIZON PROJECT

NEWCASTLE UNIVERSITY

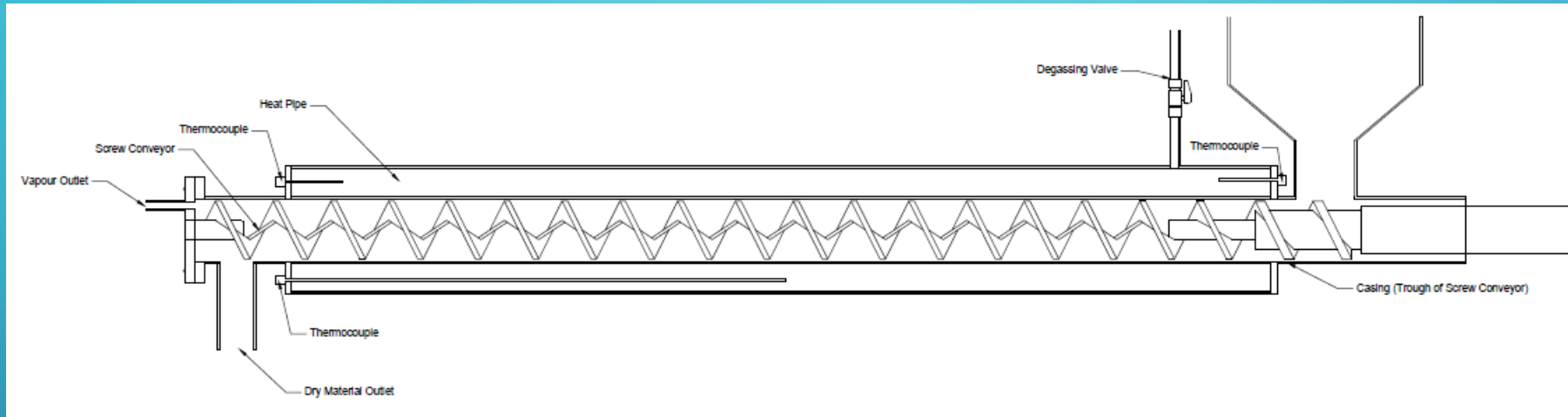
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1. OBJECTIVE OF THE PROJECT:

EUROATOMIZADO → CERAMIC RAW MATERIAL PRODUCER
(400.000 tonnes/annum, 50 million euros/annum sales)



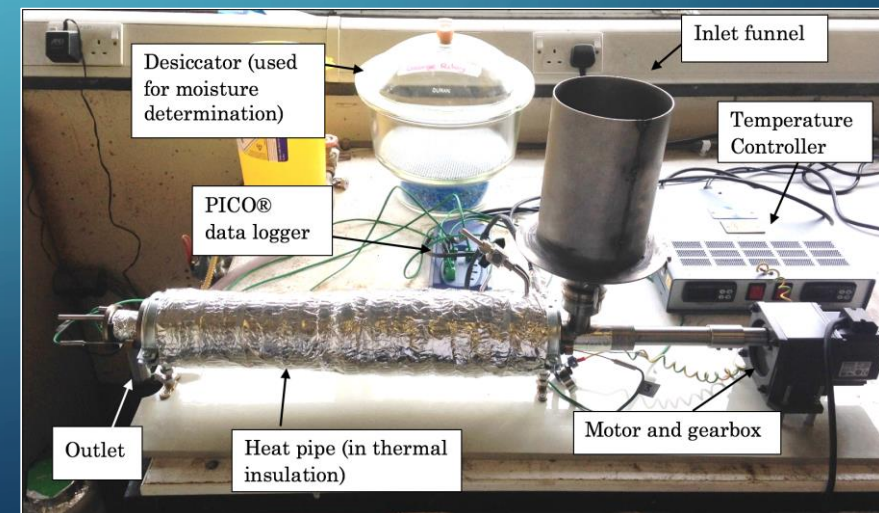
2A. PROPOSAL: HEAT PIPE-SCREW DRYER



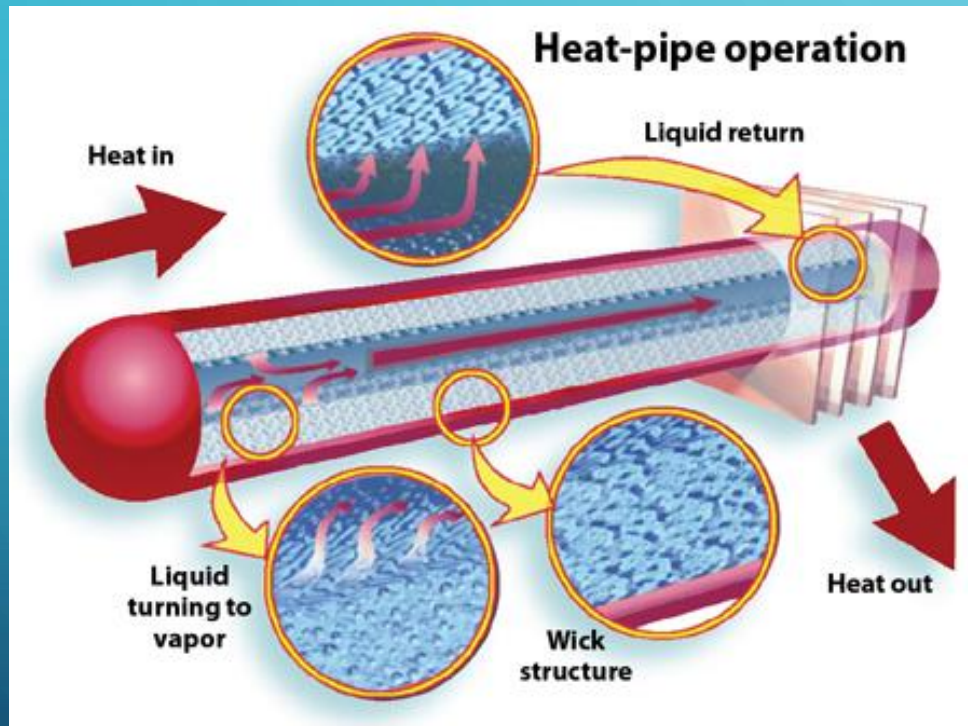
Rig setup (main equipment):

- Hopper/feeder
- Single screw
- Annular heat pipe dimensions:

Pipe	Internal Diameter (mm)	Outer Diameter (mm)
Inner Wall	34.8	38.1
Outer Wall	73.0	76.2



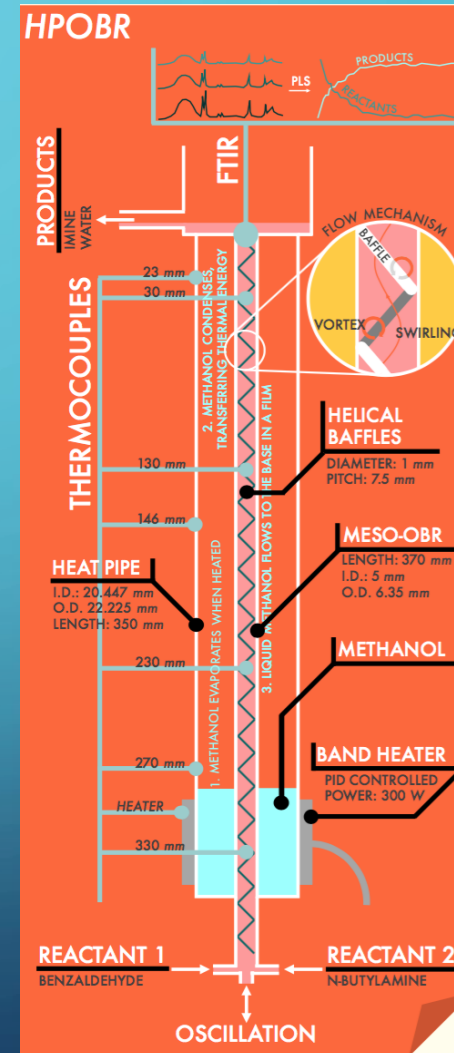
2B: HEAT PIPE REPLACING STANDARD WATER JACKET IN SCREW DRYER



HEAT PIPE ADVANTAGES:

- Isothermalisation
- Rapid thermal response

Water saving
compared to
water jacket

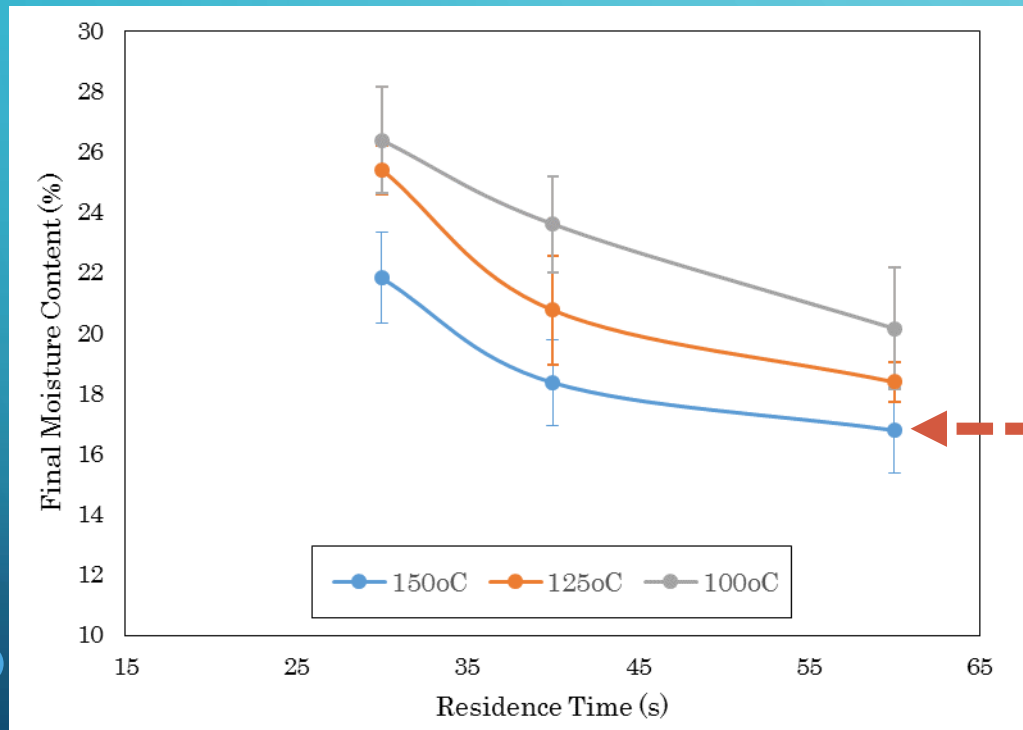


EXPERIENCE IN
NEWCASTLE
UNIVERSITY:

INTEGRATION OF HEAT
PIPE IN MESO-OBR FOR
TEMPERATURE
SCREENING
(McDonough et al.,
2015)

3. PRELIMINARY RESULTS

1. MOISTURE REMOVAL



FEED: 29% MOISTURE CONTENT

Indications for better moisture removal:

1. Higher heat pipe temperature
2. Longer residence time

2. ENERGY EFFICIENCY

Specific moisture extraction rate (SMER)

SMER = amount of water evaporated/energy used ($\text{kg}_{\text{water}}/\text{kWh}$)

Dryer Type	Average SMER ($\text{kg}_{\text{water}}/\text{kWh}$)
Rotary	0.52
Fluidised Bed	0.72
Freeze	0.08
Spray	0.45
Heat pipe/ Screw dryer	0.69

BETTER THAN MOST TECHNOLOGIES!

4. CONCLUSIONS AND FURTHER TASKS

- The energy efficiency of the heat pipe-screw dryer **is greater** than the spray dryer and freeze dryer by 50% and 750%, respectively.
Comparable to fluidised bed drying
- Moisture removal **needs to be improved** to achieve 5-7% final moisture content as in the spray dryer (currently: 16.8%)
 - **How?** - Increase hp temperature, longer RTD.
- More parameteric studies: angle of hp (effect on rtd as well)
- Design change: copper hp/water
- Examination of dried product
- Numerical simulation – design/scale up purposes
- Preparation for scale up strategies for pilot tests

5. PROPOSAL FOR DRIED PRODUCT PROCESSING

