

**Higher Technical Institute
MECHANICAL ENGINEERING DEPARTMENT**

DIPLOMA PROJECT

DESIGN OF A DROPLET GENERATOR

BY
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M/871

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HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING COURSE

DIPLOMA PROJECT

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by

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Project Report

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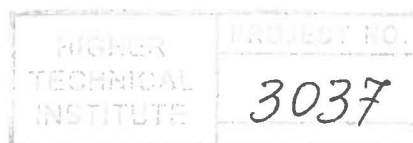
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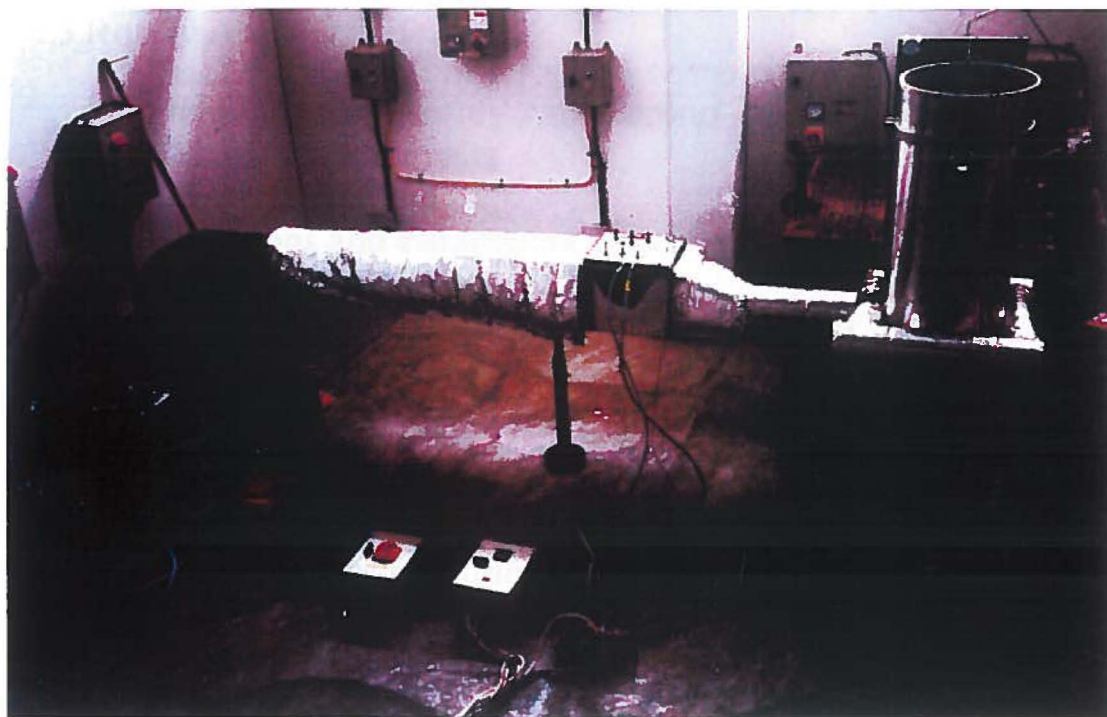
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Design Of A Droplet Generator



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The guidance throughout the whole procedure of building the setup was provided kindly by Dr. Nicos Angastiniotis.

Furthermore, it must be stated that in the effort to design and construct the spray dry unit, there was a strong collaboration with my fellow classmate Mr. Michael Zambas.

Even though the duties and responsibilities associated with my project were distinctly different than my classmate's, we both found ourselves numerous times working along side.

Due to the complexity of the construction we coordinated our efforts for a mutual exchange of feedback.

The above procedural steps were dictated to us by the many variables, parameters and adversity which encountered during our concerted effort.

Many individuals have provided their input in achieving the goals of the project.

For the setup some expensive equipment were needed which were impossible to be purchased. For example it was impossible to include in the projects budget a blower of 5HP. This, was provided for free by the "ΣΙΒΑ-ΛΑΡΤΙΚΟΝ" company. More specifically it was provided by the partner Mr. Giotis Konnaris who also provided us with his knowledge and experience about spray drying which is his field of operation at his factory. Mr. Giotis also provided us with an inverter for frequency control of the blower.

Besides the blower and inverter the setup includes a gear pump to supply the nozzle with 15 bars of liquid solution.

We would like to thank Mr. Marios Panagiotou of “DEKSA” who sometimes his persistence and good will exceeded ours in times we were ready to give up. Mr. Marios was present every day during the experiments and he also provided us, his knowledge, and a gear pump(s)☺ as well as a pressure manometer.

Special thanks to the industries that provided us both the chamber and the air channel. These were manufactured by “Christakis Agathaggelou Ltd” and “Arhimedes Factory” respectively. We were impelled to construct the above due to the fact that there were inadequate materials and equipment in the H.T.I for the purposes of our project.

Finally we would like to thank the instructors from the electrical department, MR. Costas Georgiades, Mr. Panicos Hatzimichael, and the lecturer Mr. John Demetriou, whom without their personal assistance and care we would not have been able to operate the whole setup.

We thank once more everyone for their assistance for the completion of our project.

Abstract:

Intimate mixing of metallic constituents is enabled by dissolving soluble salts of metallic species in liquid medium. Subsequent atomization and explosive drying of the droplets result in close coordination of the metallic elements. The process yields an intimate mixing of the metallic constituents with virtually no limitation with regards to the choice of the metallic constituents.

The method outlined in this project deals with the specifics of the design of the spray dryer the limitations and optimization parameters. Actual construction parameters are also presented with cost analysis in relation to effectiveness and minimal cost.

It has to be emphasized that the method enables the making of engineering composites, which are otherwise impossible to be obtained due to the immiscibility of the liquid phases of the constituent metallic species

INTRODUCTION

The purpose of my project is the design and construction of a droplet generator (atomization) which is a process involved in Spray Drying.

Spray Drying is by definition the transformation of feed from a fluid state into a particulate form by spraying the feed into a hot medium. The resulting dried product conforms to powders, granules or agglomerates.

The form of which depends upon the physical and chemical properties of the feed and the dryer design and operation.

Generally the Spray Drying consists of four process stages:

1. Atomization of feed of liquid into a spray
2. Spray-Air contact (mixing and flow)
3. Drying of spray (moisture/volatile evaporation)
4. Separation of dried product from the air

Intensive research and development in spray drying is becoming a highly competitive means of processing a wide variety of products. Some applications, nowadays concentrate on:

- Chemical industry products
- Food industry products
- Intimate mixture of metallic salts which result in mixing of constituents (**nanotechnology**)
- Pharmaceutical-Biochemical industry products

Some of the advantages of Spray Drying are:

1. Continues operation
2. Pre-determined product
3. Tailoring of product (morphology, composition)

Also by Spray Drying we can control

- Particle size distribution
- Moisture content

Our focus was to build a cost-effective spray-drying unit to demonstrate the capabilities entailed in spray drying.

All components were selected and assembled according to sound engineering principles and with the objective of minimizing cost. The operational capabilities was tested and were evaluated.

1.1 INTRODUCTION

The atomization stage in spray drying produces from liquid bulk a spray of droplets having a high surface to mass ratio. The dried product that results from moisture evaporation of atomized spray can be made to possess the desired particle size distribution through control of the atomization variables.

The ideal spray is one of small individual droplets of equal size. Heat and mass transfer rates and drying times are then the same for all droplets in the spray, ensuring uniform dried-product characteristics. Droplets of a spray evaporate quickly and the short drying times involved maintain low droplets temperature due to the cooling effect that accompanies evaporation.

No product deterioration can take place due to heat, if correct atomization is combined with a suitable drying-chamber design to give a product residence time just sufficient for completion of moisture removal. **The ideal requirement of an atomizer is to product homogeneous spray.**

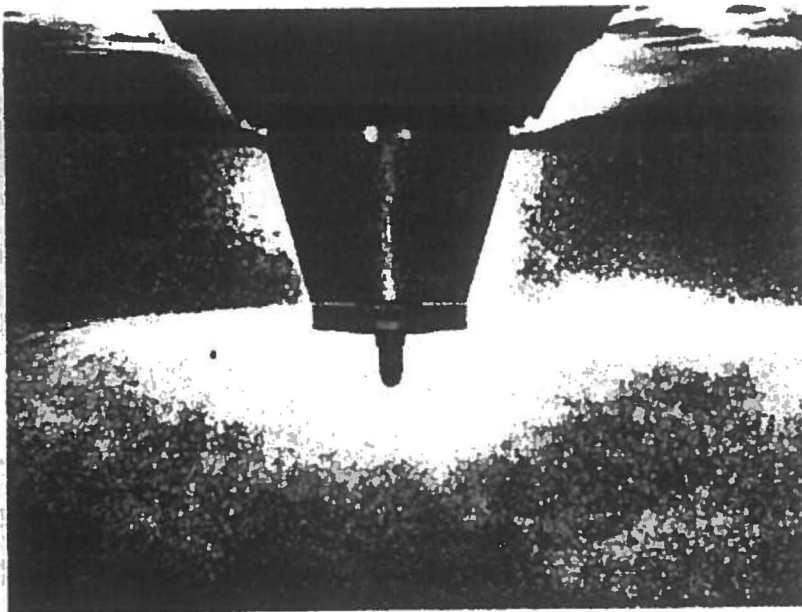


Figure 1.1 Atomizer in operation