

HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

**STATISTICAL PROCESS CONTROL IN A
MANUFACTURING INDUSTRY**

By

PHOTIS KAKOYIANNIS (M/748)

JUNE 1996

STAT
A M

HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING COURSE

DIPLOMA PROJECT

STATISTICAL PROCESS CONTROL IN A MANUFACTURING INDUSTRY

(M/748)

BY: PHOTIS KAKOYIANNIS

JUNE 1996

HIGHER TECHNICAL INSTITUTE	PROJECT NO 2590
----------------------------------	--------------------

**STATISTICAL PROCESS CONTROL IN
A MANUFACTURING INDUSTRY**

By

Photis Kakoyiannis

**Project Report
Submitted to**

**the Department of Mechanical Engineering
of the Higher Technical Institute
Nicosia - Cyprus**

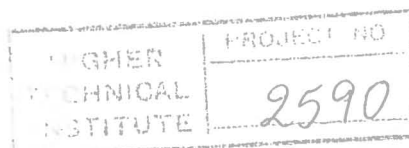
in partial fulfilment of the requirements

**for the diploma of
TECHNICIAN ENGINEER**

in

MECHANICAL ENGINEERING

June 1996



CONTENTS

	<u>page</u>
<u>ACKNOWLEDGEMENTS</u>	1
<u>ABSTRACT</u>	2
<u>CHAPTER 1</u>	3
1. Introduction	4
1.1 Definition of Quality & Control.	4-5
1.2 What is Quality Control (QC).	6
1.3 What is Statistical Process Control (SPC).	6-11
<u>CHAPTER 2</u>	12
2. Processes involved throughout the Wastewater Treatment Plant of Pittas Dairy Industries Ltd - Existing practices status.	13
2.1 Description of Pittas Dairy Industries Ltd.	13-14
2.1.1 Policy of Pittas Dairy.	14-15
2.1.2 Milk Cycle and treatment of the wastewater.	16-17
2.1.3 Pittas Dairy in harmony with the nature.	18
2.2 Process description of Pre-treatment of Wastewater.	19
2.2.1 Wastewater.	19
2.2.2 Process Flow of pre-treatment.	19
2.2.3 Detailed description of the process.	20-22
2.3 Process description of Anaerobic Treatment.	23
2.3.1 Introduction.	23
2.3.2 Environmental factors.	23-24
2.3.3 Toxicity.	24-25
2.3.4 Detailed description of process.	25-27
2.4 Process description of Aerobic Post-treatment.	27
2.4.1 Introduction.	27-28
2.4.2 Detail Process Description.	28-29
2.5 Figures from the WWTP.	30-35

<u>CHAPTER 3</u>	36
3 Inspection and testing for Quality Control.	37
3.1 Quality Control System.	37
3.1.1 Introduction.	37
3.1.2 International and National specifications of wastewater.	38-39
3.2 Methods of Inspection, Sampling and Testing.	39
3.2.1 Inspection.	39-40
3.2.2 Collection and Preservations of samples.	40
3.2.3 Daily measurements and Analyses.	41
3.2.4 Weekly measurements and Analyses.	41
3.2.5 Laboratory Tests.	41
3.2.5.1 Temperature (t).	41-42
3.2.5.2 pH	42
3.2.5.3 Biochemical Oxygen Demand (BOD ₅).	42-43
3.2.5.4 Chemical Oxygen Demand (COD).	43
3.2.5.5 Total Kjeldahl Nitrogen (TKN).	44
3.2.5.6 Ammonium Nitrogen N(NH ₄).	44
3.2.5.7 Volatile Fatty Acids (VFA) and Alkalinity.	44
3.2.5.8 Fat, Oil and Grease (FOG).	45
3.2.5.9 Total and Volatile Suspended Solids (TSS and VSS).	45
3.2.5.10 Phosphorus (P).	45
3.2.5.11 Hydrogen Sulphide (H ₂ S) and Carbon Dioxide (CO ₂) in Biogas.	46
3.2.5.12 SVI Factor.	46
3.3 Table and Flowchart.	46-48

<u>CHAPTER 4</u>	49
4. Analyses of Data collected with Control Chart (Data Charting and Analyses).	50
4.1 Introduction.	51
4.1.1 Data collection.	51
4.1.2 Control Charts.	51-53
4.1.3 Construction of a Control Chart.	54-59
4.2 Building of the charts.	58
4.2.1 Chart No.1	60-61
4.2.2 Chart No.2	62-63
4.2.3 Chart No.3	64-66
4.2.4 Chart No.4	67-69
4.2.5 Chart No.5	70-72
<u>CHAPTER 5</u>	73
5. Recommendations for the improvement of the WWTP, and for Public Health aspects.	74
5.1 Introduction.	74
5.2 Recommendations for the improvement of the WWTP.	74-77
5.3 Recommendations for Public Health aspects.	77-78
<u>CHAPTER 6</u>	79
6. Summary and conclusions.	80
6.1 Summary.	80-81
6.2 Conclusions.	81-82
REFERENCES	83-84

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Dr. L. Lazaris, lecturer in Mechanical Engineering, at H.T.I., for his valuable assistance and guidance offered to me in carrying out the presented diploma project.

I wish also to thank Mr. I. I. Angeli, Laboratory assistant 1st grade in H.T.I. for his help offered to me by providing me with references and information about this project.

Also my thanks to the Board of Directors of Pittas Dairy Industries Ltd, and especially to Mr. A. Pittas, Production Manager, for permitting me to carry out this project in their industry, Mr. A. Hadjipetrou, Factory Manager, Mr. A. Ioannou, Quality Manager, and Mr. M. Selipas, Environmental Supervisor of the WasteWater Treatment Plant (W.W.T.P.), for their help offered by providing me with references and information about this project.

Finally, I would like to thank my father for his patience and help given to me on this project. To the rest of my family and specially my sister Vicky, for their support.

ABSTRACT

The objectives of this project are to, study traditional and modern statistical process control techniques, in the WasteWater Treatment Plant of Pittas Dairy Industries Ltd, describe the flow of the processes at the W.W.T.P., identify the existing practices status of the particular Biological Station and suggest ways for the improvement of the processes. All recommendations are done in accordance to the EMS-quality standards (BS 7750, ISO 14000 - Series).

The project was carried out in Pittas Dairy Industries in Nicosia and in particular in the (W.W.T.P.) of the same industry, situated south of Latsia.

In the first chapter reference is made on quality & control, quality control and statistical process control.

In the second chapter , a description of Pittas Dairy Industries, it's policy, the milk cycle and in particular the treatment of the wastewater through an anaerobic and aerobic process in the WWTP is underlined.

In chapter three, the methods and frequency of inspection and the analyses performed for the examination of wastewater in various stages of its treatment are described, in order to control wastewater quality.

In the fourth chapter the data collected from the analyses of the wastewater are presented and are analysed by the use of control charts.

In chapter five, recommendations for the improvement of the WWTP and for Public Health aspects are outlined.

In the last chapter the summary and the conclusions are stated.