

# RECYCLING OF RUBBER TYRES

By

ANDREAS GREGORIOU

project report submitted to the

Department of Mechanical Engineering  
of the  
Higher Technical Institute  
Nicosia, Cyprus

In partial fulfillment of the  
requirements for the diploma of

TECHNICIAN ENGINEER

IN

MECHANICAL ENGINEERING

June 1991

NUMBER	PROJECT NO
1876	

## ACKNOWLEDGEMENTS

I would like to express my thanks and appreciation to :

Dr A. Stassis - Lecturer in the Mechanical Engineering  
Department of H.T.I

Dr L. Lazari - Lecturer in the Mechanical Engineering  
Department of H.T.I

Dr K. Tsimillis - Chemist , CYS officer of the ministry of  
commerce and industry

for their useful assistance and guidance throughout the  
completion of this project.

I also like to express my appreciation to Mr David Wright and  
Mr John Ioannou for the provision of valuable information and  
research facilities.

Finally, i take this last opportunity to thank H.T.I staff and  
all those from whom i have been acquiring knowledge for their  
patience and co-operation.

Gregoriou Andreas  
3rd year student in  
Mechanical Engineering,  
H.T.I

## ABSTRACT

The main subject of this project is a survey on recycling of rubber tyres with a special reference to Cyprus standards. It consists of five(5) chapters.

The first chapter deals with the need of recycling as well as with some general information for existing plants. The second chapter is actually a study for the possibility of recycling rubber tyres in Cyprus, stressing the energy lost from the disposed old tyres. Special reference is made on health and environmental factors. Chapter three covers the methods of rubber tyres recycling describing in detail the operation of existing plants all over the world. The next chapter the fourth one is a suggestion of a possible plant that can be constructed and operated in Cyprus utilizing the capacity of generated old tyres. Drawings and design specifications of this plant are provided as a first approach to the construction. The last chapter is a financial justification for the proposed design in chapter 4 providing cost and profit calculations. The appendices at the end include tables used as reference during the design process.

# CONTENTS

ACKNOWLEDGEMENTS

ABSTRACT

INTRODUCTION

## CHAPTER 1 - RECYCLING OF RUBBER TYRES

	PAGES
1.1 THE NEED OF RECYCLING .....	1
1.2 RUBBER RECYCLING PLANTS .....	2

## CHAPTER 2 - THE POSSIBILITY OF RECYCLING SCRAP RUBBER TYRES IN CYPRUS

2.1 IMPORTS .....	4
2.2 DESTINATION OF SCRAP RUBBER TYRES .....	5
2.3 ENVIRONMENTAL AND HEALTH FACTORS .....	5
2.4 RECYCLING - ENERGY LOST - COST SAVINGS .....	10
2.4.1 IS IT FEASIBLE ? .....	10
2.5 CONCLUSIONS .....	11

## CHAPTER 3 - METHODS OF RUBBER TYRE RECYCLING

3.1 RUBBER RECYCLING .....	13
3.2 FUEL SOURCE .....	13
3.2.1 THE USE OF RUBBER TYRES AS ADDITIONAL FUEL IN CEMENT ROTARY KILNS .....	14
3.3 PYROLYSIS .....	19
3.4 DEPOLYMERIZED SCRAP RUBBER - D.S.R .....	21
3.5 IN ASPHALT / CONCRETE .....	21
3.5.1 IN ASPHALT .....	21

3.5.2	IN CONCRETE .....	23
3.6	RUBBER RECLAIMING .....	23
3.6.1	DIGESTING .....	24
3.6.2	HEATER OR PAN METHOD .....	24
3.6.3	THE RECLAIMATOR PROCESS .....	24
3.6.4	GENERAL ON RECLAIMNG .....	25
3.6.5	RUBBER COMPOUNDING .....	26
3.6.5.1	RECLAIMED RUBBER AND GROUND SCRAP .....	26
3.7	TYRE RETREADING .....	27
3.8	GRINDING .....	27
3.8.1	GROUNDING RUBBER IN APPLICATION .....	29
3.9	OTHER USES .....	30
3.10	SYNOPSIS .....	30

#### CHAPTER 4 - A POSSIBLE PLANT FOR CYPRUS

	.....	33
4.1	RECYCLED RUBBER GRANULATES .....	33
4.2	DESCRIPTION OF A TYPICAL FLOWSHEET FOR TREATMENT OF THE RUBBER TYRES FOR THE PLANT UNDER SUGGESTION .....	34
4.2.1	A MORE DETAILED APPROACH TO THE PLANT UNDER SUGGESTION .....	35
4.3	DESIGN OF THE RUBBER GRINDING PLANT .....	35
4.3.1	DESIGN OF THE FEEDER .....	35
4.3.2	DESIGN OF THE BELT CONVEYOR SYSTEM .....	40
4.3.2.1	TERMS OF REFERENCES .....	40
4.3.2.2	MAIN CHARACTERISTICS OF A CONVEYOR BELT .....	41
4.3.2.3	DETERMINATION OF THE LOAD CARRIED BY EACH ROLL .....	41
4.3.2.4	RETURN IDLER SELECTION .....	44
4.3.2.5	SUPPORTING STRUCTURE SELECTION .....	44
4.3.2.6	CAPACITY CALCULATION .....	44

4.3.2.7	OPERATING POWER FOR HORIZONTAL CONVEYOR .....	45
4.3.2.8	BELT SELECTION .....	46
4.3.2.9	INPUT ROTATIONAL SPEED TO CONVEYOR .....	46
4.3.2.10	SELECTION OF DRIVING UNIT .....	46
4.3.2.11	SELECTION OF GEAR UNIT FOR MOTOR .....	47
4.3.2.12	OPERATING POWER FOR INCLINED CONVEYOR .....	47
4.3.2.13	INPUT ROTATIONAL SPEED TO CONVEYOR .....	48
4.3.2.14	SELECTION OF DRIVING MOTOR .....	49
4.3.2.15	SELECTION OF GEAR UNIT FOR MOTOR .....	49
4.3.3	DESIGN OF THE ENTRANCE CHUTE .....	49
4.3.4	DESIGN OF THE CONVEYOR SYSTEM SUPPORTS .....	50
4.3.4.1	SUPPORTS OF THE HORIZONTAL CONVEYOR .....	50
4.3.4.2	SUPPORTS OF THE INCLINED CONVEYOR .....	51
4.3.5	ELECTOMAGNET SELECTION .....	53
4.3.6	SIEVE DESIGN .....	53
4.3.7	SHREDDER AND MILL / GRINDER .....	53
4.4	GENERAL FOR THE PLANT .....	54

## CHAPTER 5 - FINANCIAL JUSTIFICATION

	.....	62
5.1	FINAL CONCLUSIONS .....	63

APPENDICES

REFERENCES