LEATHER WASTE - FLUIDIZED BED COMBUSTION CHARACTERIZATION IN LABORATORY AND DEMONSTRATION SCALE

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MINISTERIO
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Energéticas, Medioambientales
y Tecnológicas

INTRODUCTION

- **Footwear leather wastes are formed mainly by proteins (80%) which are high molecular weight substances formed by amino acids. The amino acids are joined by condensation forming an union peptide (CO-NH-).**

- **Footwear leather wastes present fundamentally a problem due to the geographical concentration of the sector and to the great volume of generated wastes. Much of these wastes are throw away in landfills or they are uncontrolled incinerated, but these techniques are becoming increasingly expensive and restricted.**

INTRODUCTION

Europe is an important player in the international leather market

- **About 25 % of the world’s leather production**
- **Over 3.000 companies and some 50.000 people directly employed in the sector**
- **About 44.000 tonnes in footwear sector in 2000.**
- **Italy and Spain are the European countries that produce more wastes.**

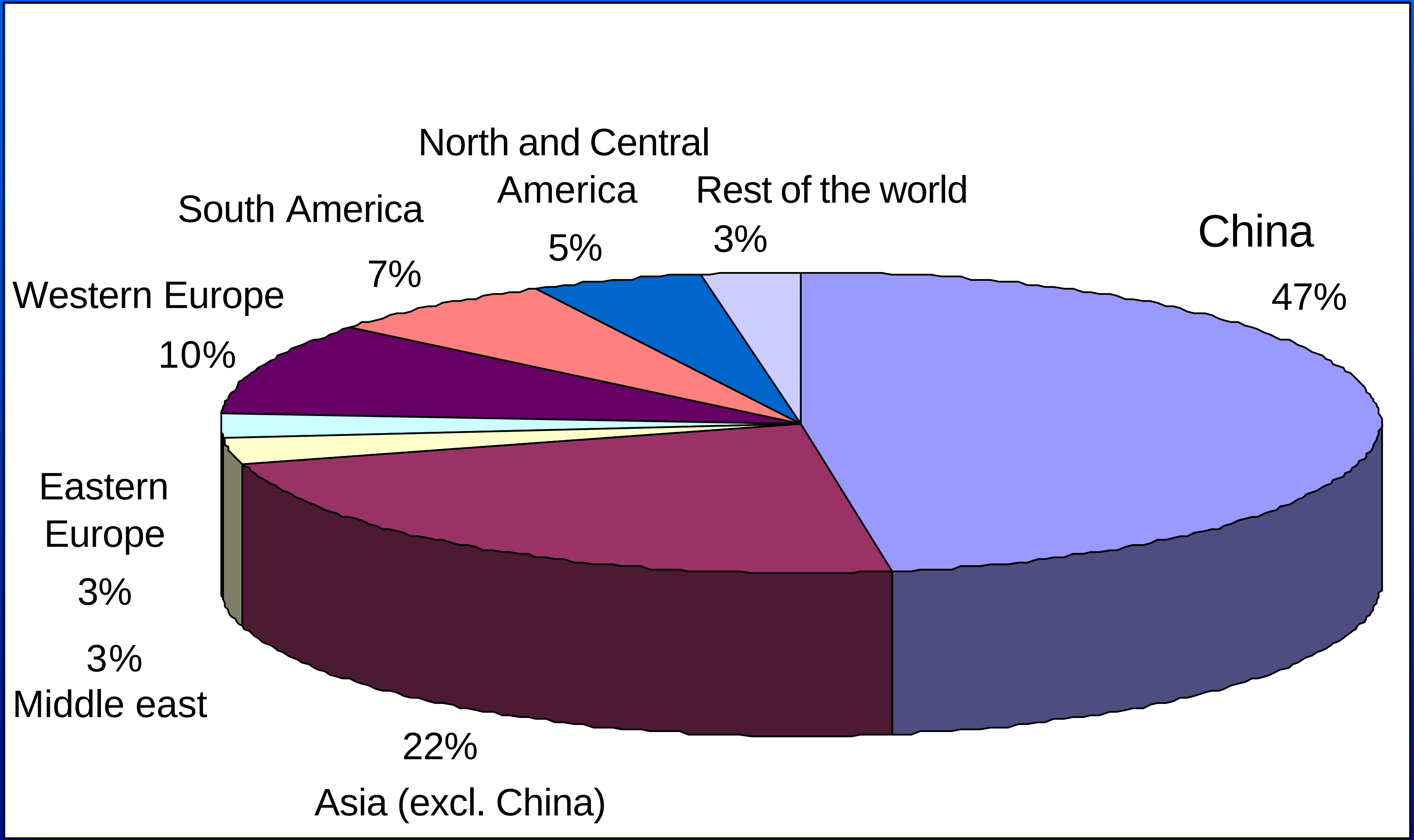
INTRODUCTION

Dry and finished leather scraps
produced by all industries – world wide basis

	t/year	%
Leather making	154.436	20.6
Gloves	28.423	3.8
Footwear	**446.592**	**59.4**
Leather goods	80.323	10.7
Garments	41.434	5.5
Total	751.209	100

INTRODUCTION

Wastes generated by the footwear manufacturing - % of world area

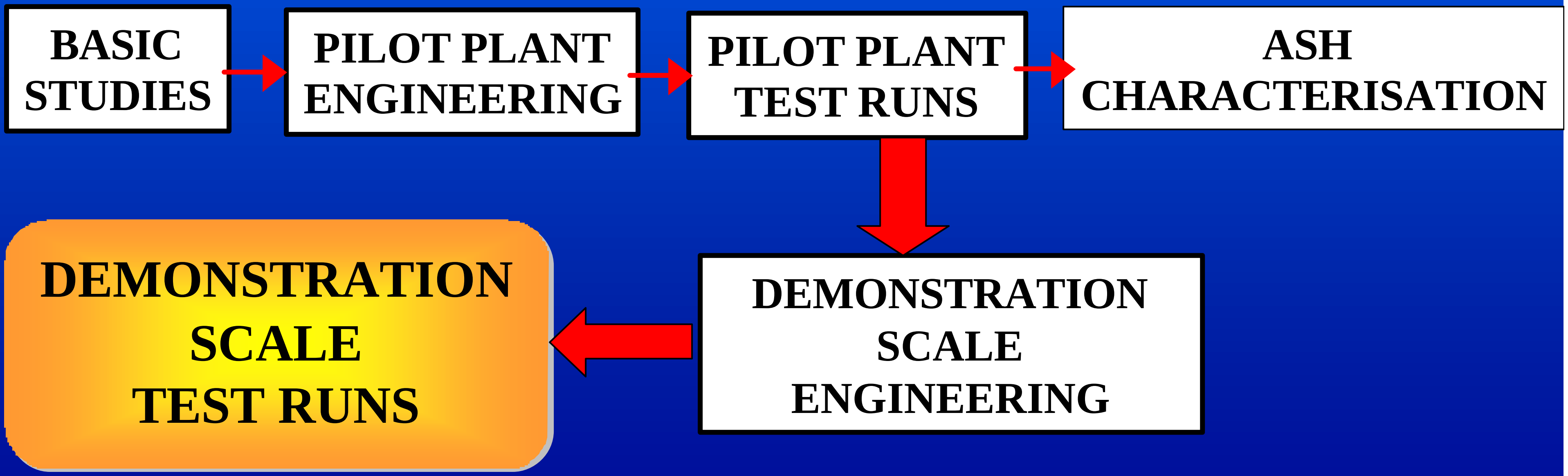


LEATHER WASTE ANALYSIS

PROXIMATE ANALYSIS, %wt d.b.	
MOISTURE, a.r.	13.3
VOLATILE MATTER	76.55
ASH	5.25
CARBON FIXED	18.2
ULTIMATE ANALYSIS, %wt d.b.	
CARBON	54.9
HYDROGEN	5.1
SULPHUR	1.4
OXYGEN	19.2
NITROGEN	14.1
CHLORINE	0.8
CHROMIUM	3.2
HHV, MJ/kg	19.6
LHV, MJ/kg	18.3
BULK DENSITY, kg/Nm^3	200

OBJECTIVES

- TO MAKE USE OF HEATING VALUE OF WASTES THROUGH COMBUSTION
- TO DEMONSTRATE THE TECHNICAL FEASIBILITY OF THE BFB AS A SUITABLE TECHNOLOGY TO DISPOSE OF THE WASTE



BASIC STUDIES

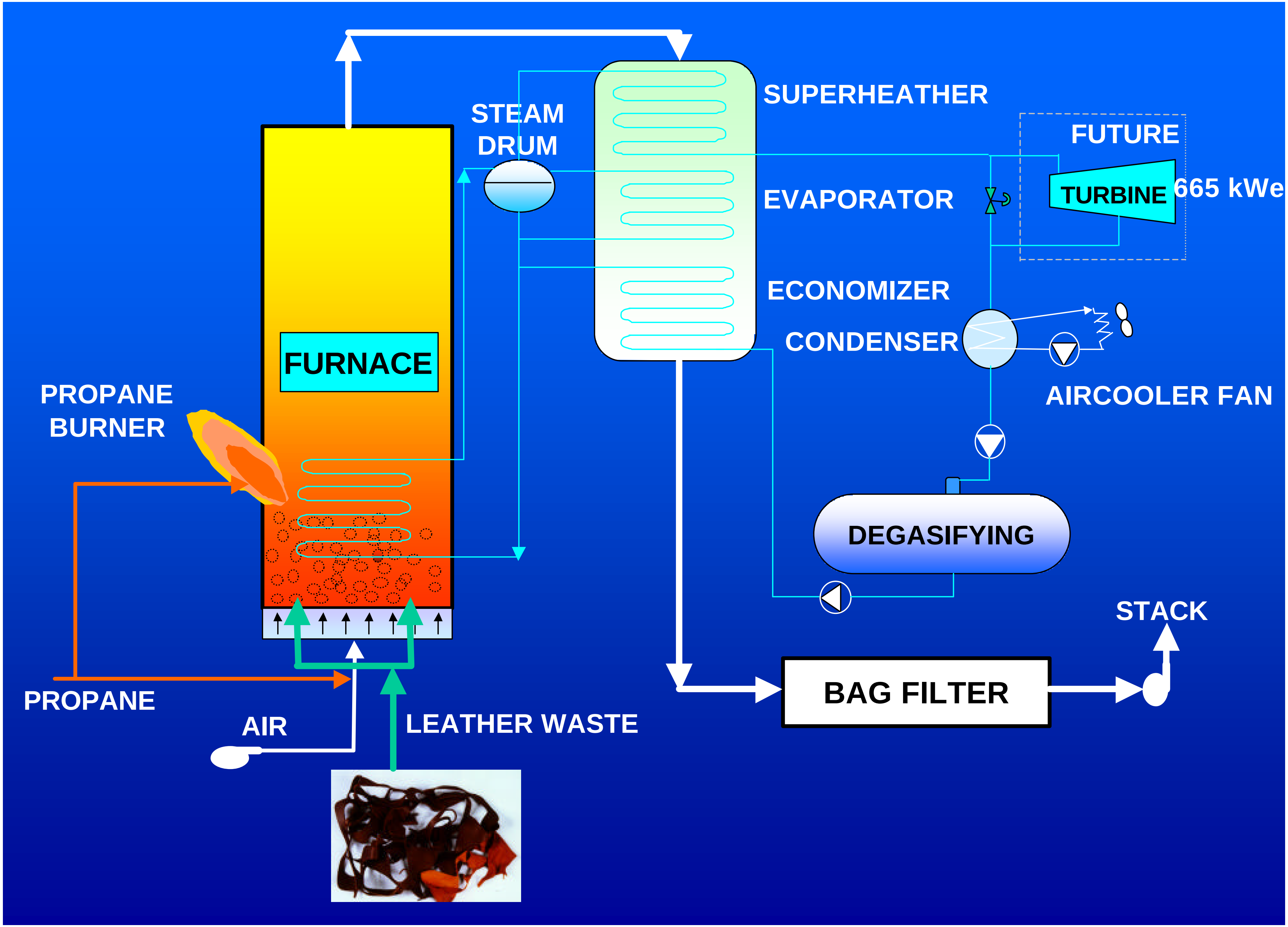
PILOT PLANT ENGINEERING

PILOT PLANT TEST RUNS

ASH CHARACTERISATION

DEMONSTRATION SCALE ENGINEERING

DEMONSTRATION SCALE TEST RUNS


STEAM DRUM
SUPERHEATHER
FUTURE
TURBINE
665 kWe
EVAPORATOR
ECONOMIZER
CONDENSER
FURNACE
PROPANE BURNER
AIRCOOLER FAN
DEGASIFYING
STACK
BAG FILTER
PROPANE
AIR
LEATHER WASTE

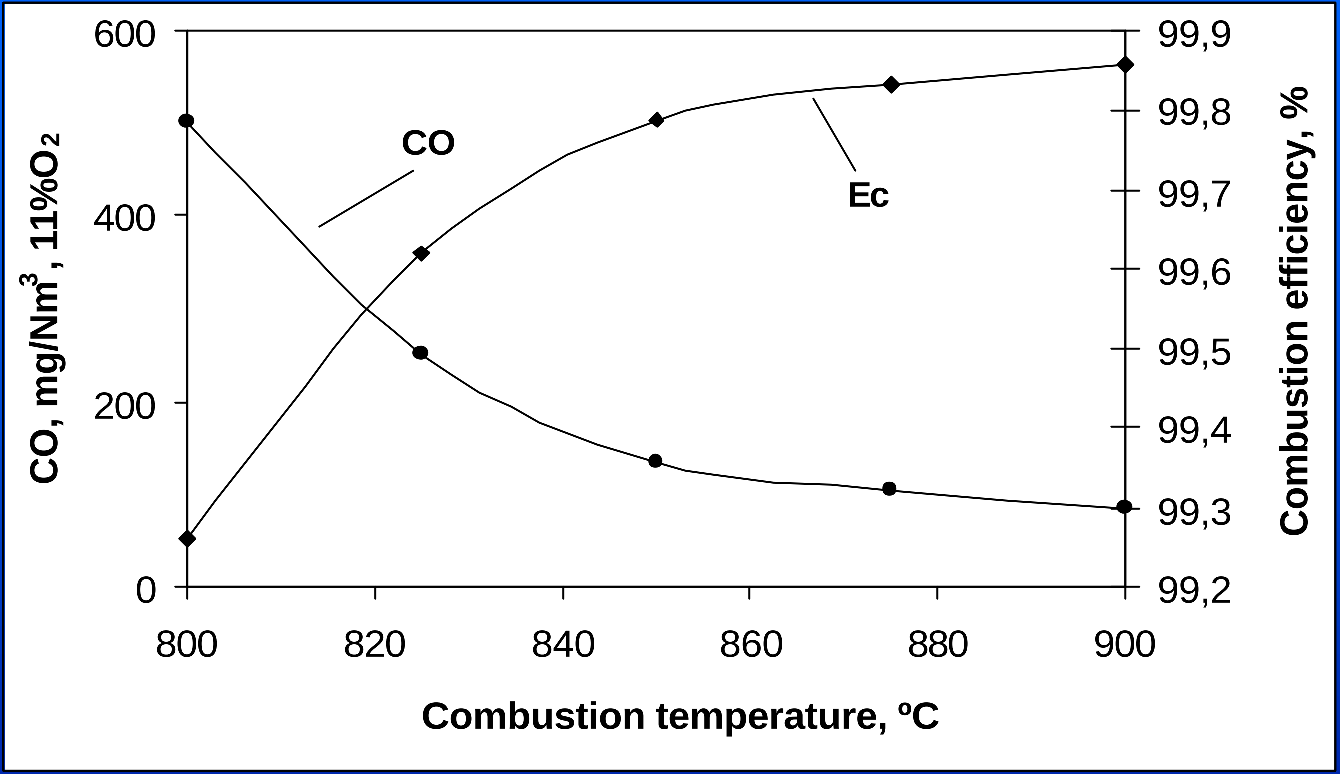
DESIGN PARAMETERS

THERMAL POWER	**3.6 MW**
SECTION	**4.5 m^2**
COMBUSTION TEMPERATURE	**850 ºc**
FLUIDIZING VELOCITY	**1.2 m/s**
FEED RATE (biomass)	**665 kg/h**
STEAM FLOW RATE	**3700 kg/h**
STEAM PRESSURE	**30 Bares**
STEAM TEMPERATURE	**400ºC**

Operating Conditions

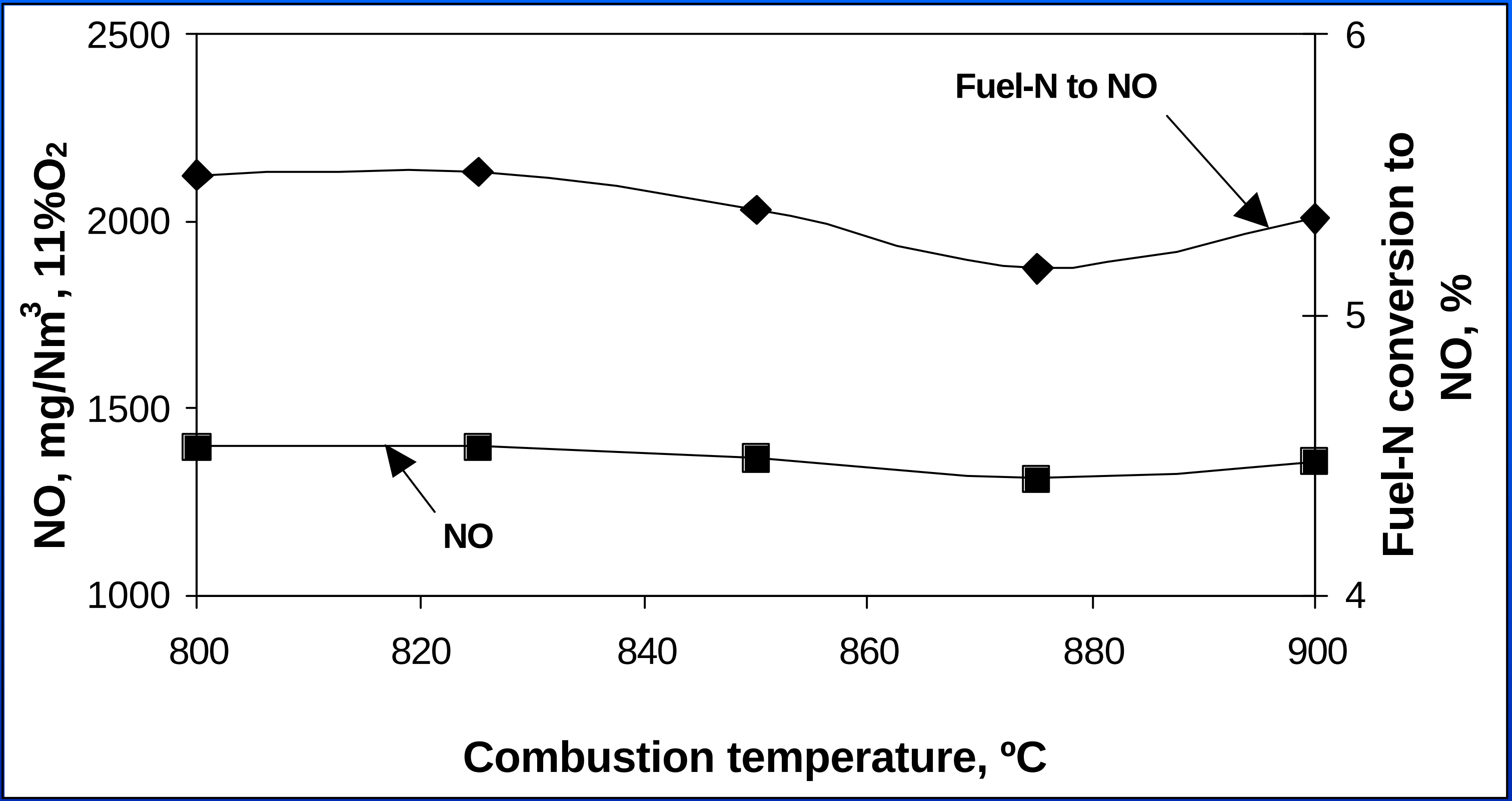
Bed temperature (°C)	800 – 900
Freeboard temperature (°C)	750 – 850
Waste feed rate (kg/h)	450 – 700
Fluidising velocity (m/s)	0.8 – 1.2
Excess air (%)	20 - 40
Average waste particle size (mm)	5 – 15
Static Bed height (mm)	300
Sand particle size (mm)	0.4 – 1

FLUE GASES EMISSIONS (I)



CO emissions depend on the bed temperature. Combustion efficiency increases slightly with the combustion temperature.

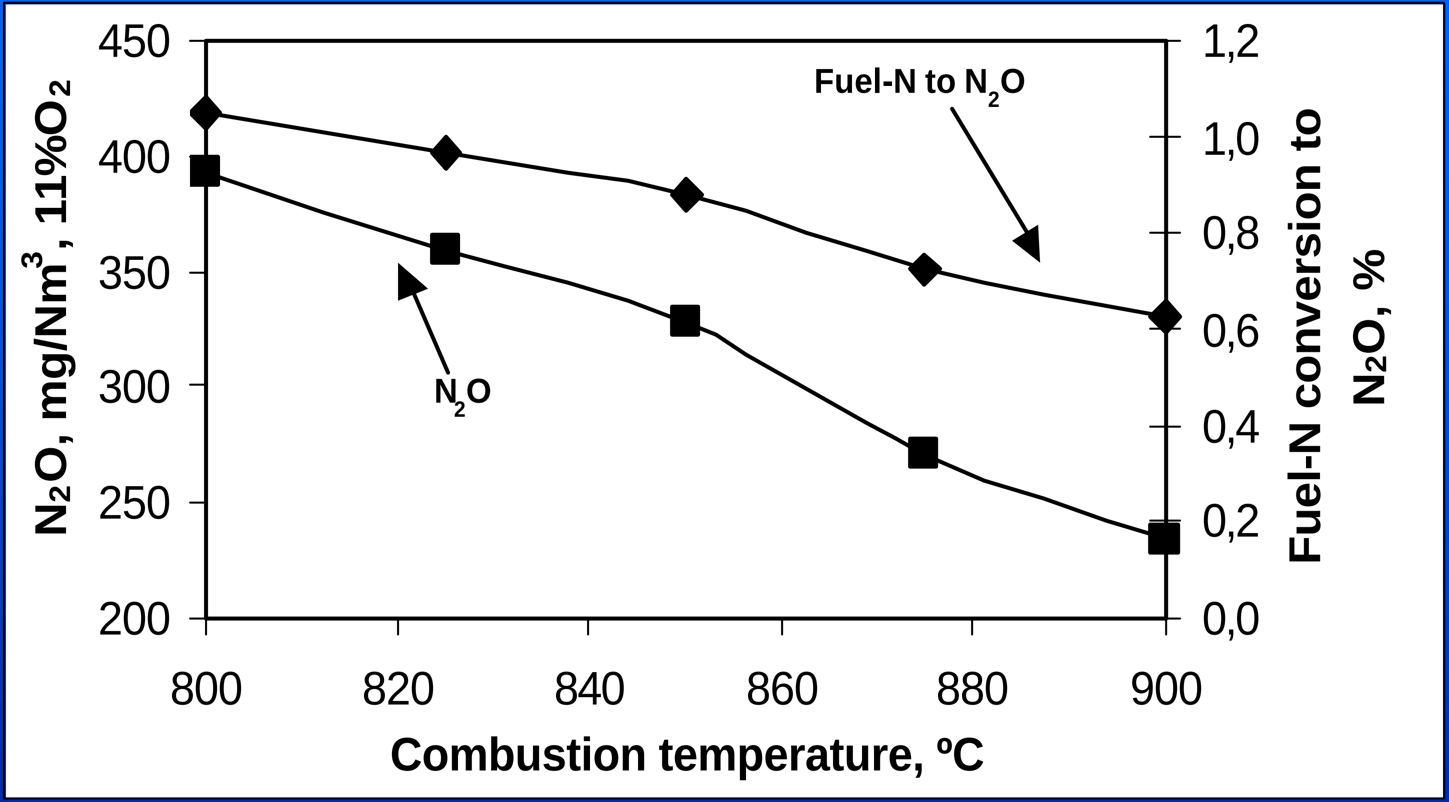
FLUE GASES EMISSIONS (II)



NO emissions and fuel-nitrogen conversion remained constant with the increase of temperature.

Formation and reduction reactions of NO are the same importance.

FLUE GASES EMISSIONS (III)



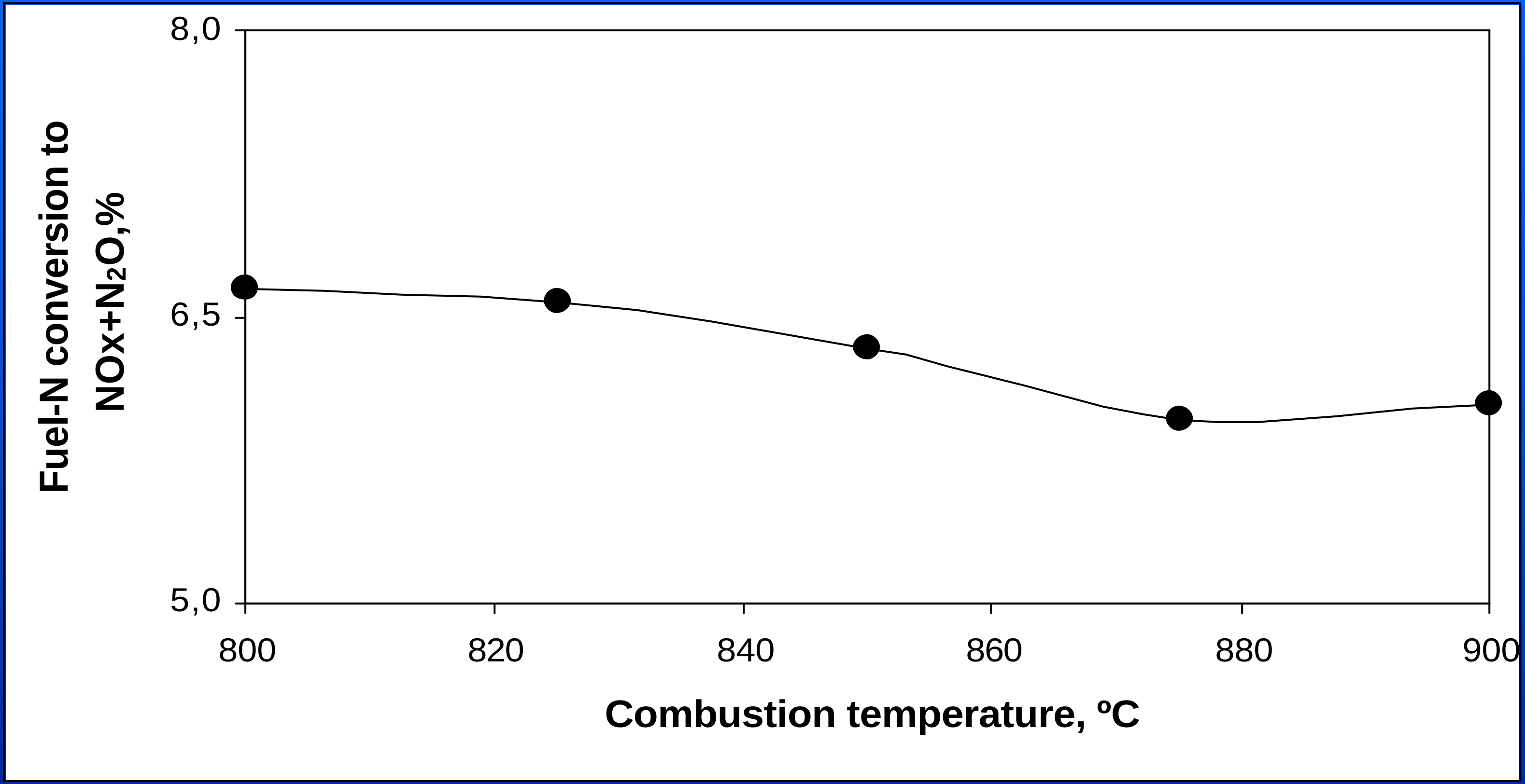
N_2O emission decreases with increasing temperature.

Higher H* and OH* radical concentrations at higher temperatures.

Thermal destruction of N_2O rises sharply with increasing temperature

$$N_2O + H^*, OH^* \longrightarrow N_2 + OH^*, HO_2^*$$

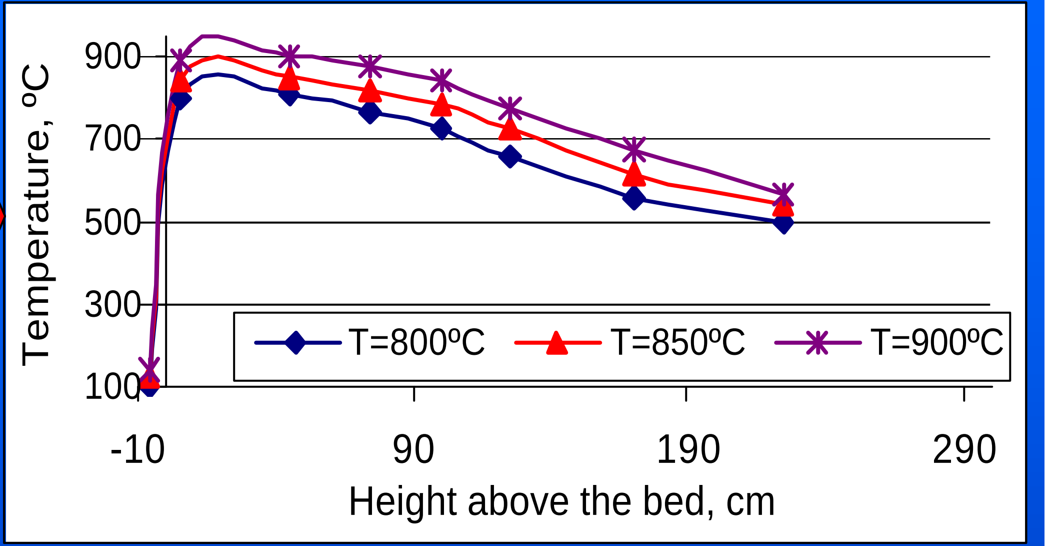
FLUE GASES EMISSIONS (IV)

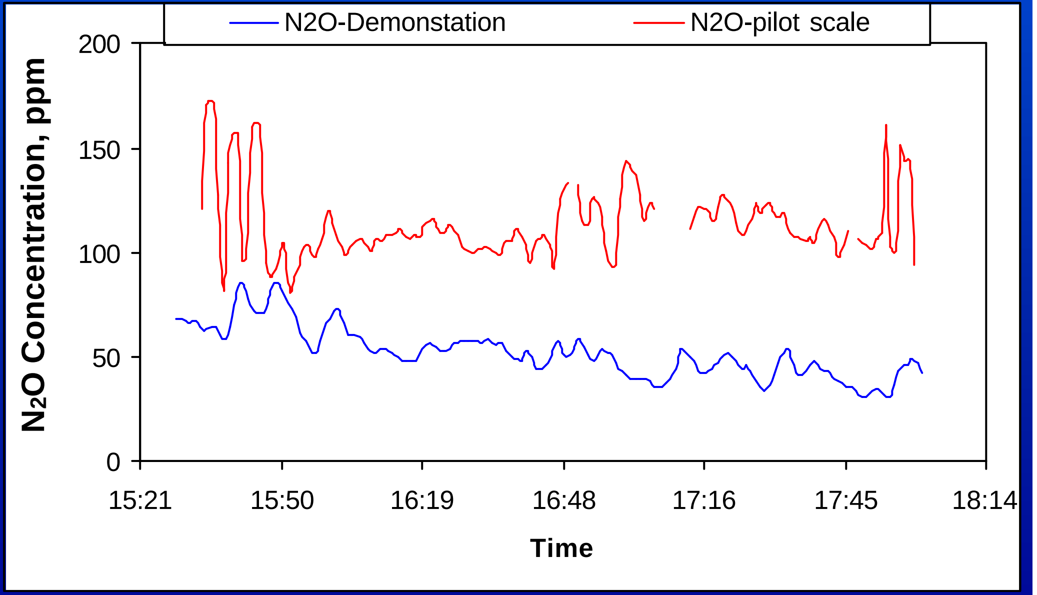


The global fuel-N conversion to N_2O and NOx was found to decrease very slightly with the temperature.

FLUE GASES EMISSIONS (V)

Bed Temperature, ºC	**850**
Freeboard Temp., ºC	**775**
O_2 (%)	**6,0**
H_2O (%)	**8,0**
CO_2 (%)	**11,0**
CO (mg/Nm^3)	**100**
SO_2 (mg/Nm3)	**2100**
NO (mg/Nm^3)	**1650**
NO_2 (mg/Nm^3)	**100**
N_2O(mg/Nm^3)	**100**
NH_3 (mg/Nm^3)	**1**
HCl (mg/Nm^3)	**11**



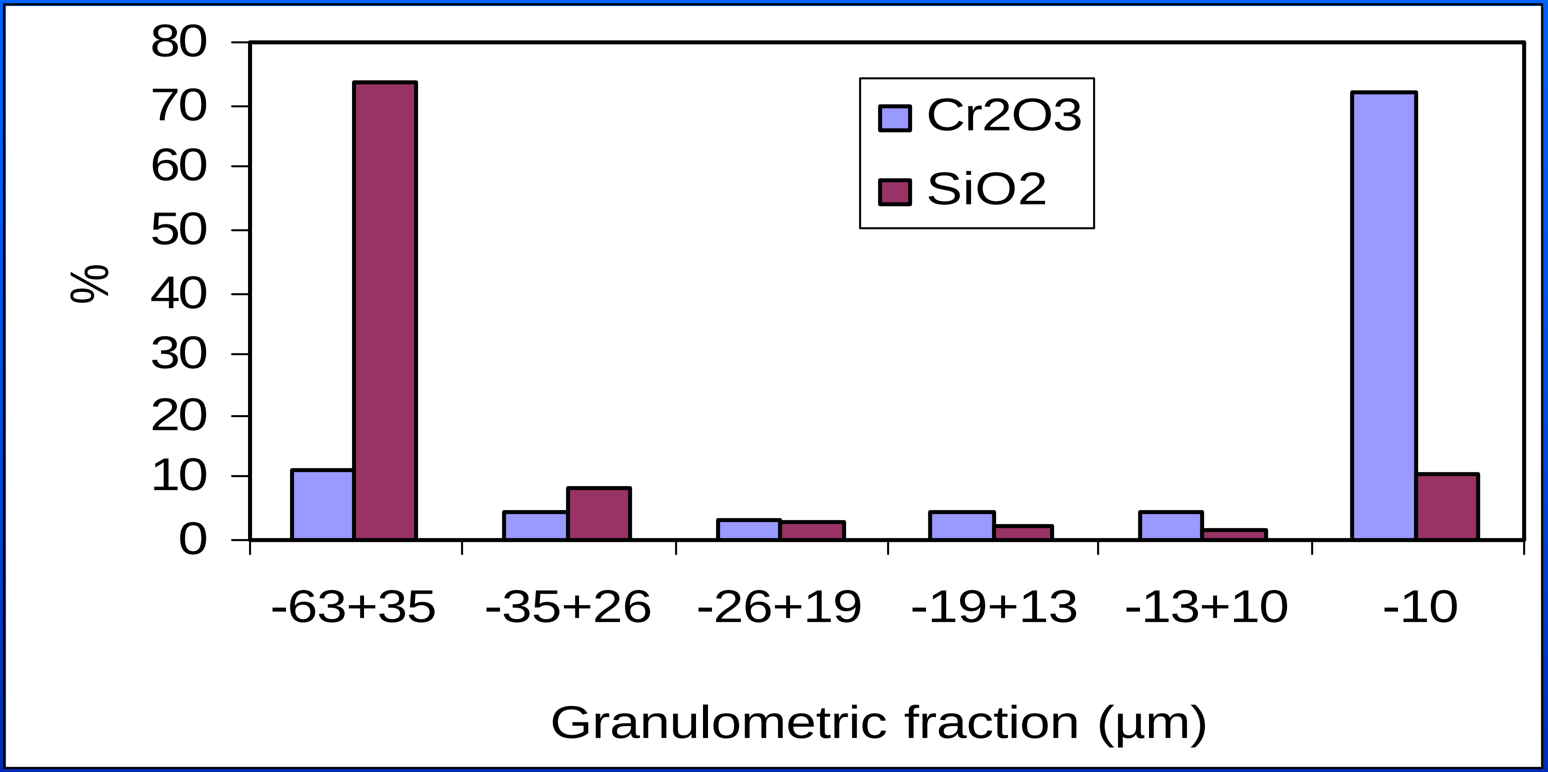


ASH CHARACTERISATION (I)

SiO_2 (%)	37,8
Cr_2O_3 (%)	32,0
Al_2O_3 (%)	4,9
CaO (%)	4,2
P_2O_5 (%)	3,7
Na_2O (%)	3,2
K_2O (%)	1,8
Fe_2O_3 (%)	1,5
MgO (%)	1,4
TiO_2 (%)	1,2

The recovery of chromium (Cr_2O_3) from ashes produced in the combustion was difficult because chromium ashes were mixed mainly with silica coming from bed.

ASH CHARACTERISATION (II)



SiO_2 was mainly concentrated in bigger particles of 35 µm, whereas Cr_2O_3 was found in smaller particles of 10 µm.