

Effect of devolatilization temperature and type of devolatilization atmosphere on char morphology of coal and bagasse

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CLEAN COAL
TECHNOLOGIES
(CCT2017)

CAGLIARI -ITALY

OUTLINE

- Motivation
- Material and methods
- Result
- Conclusions

MOTIVATION

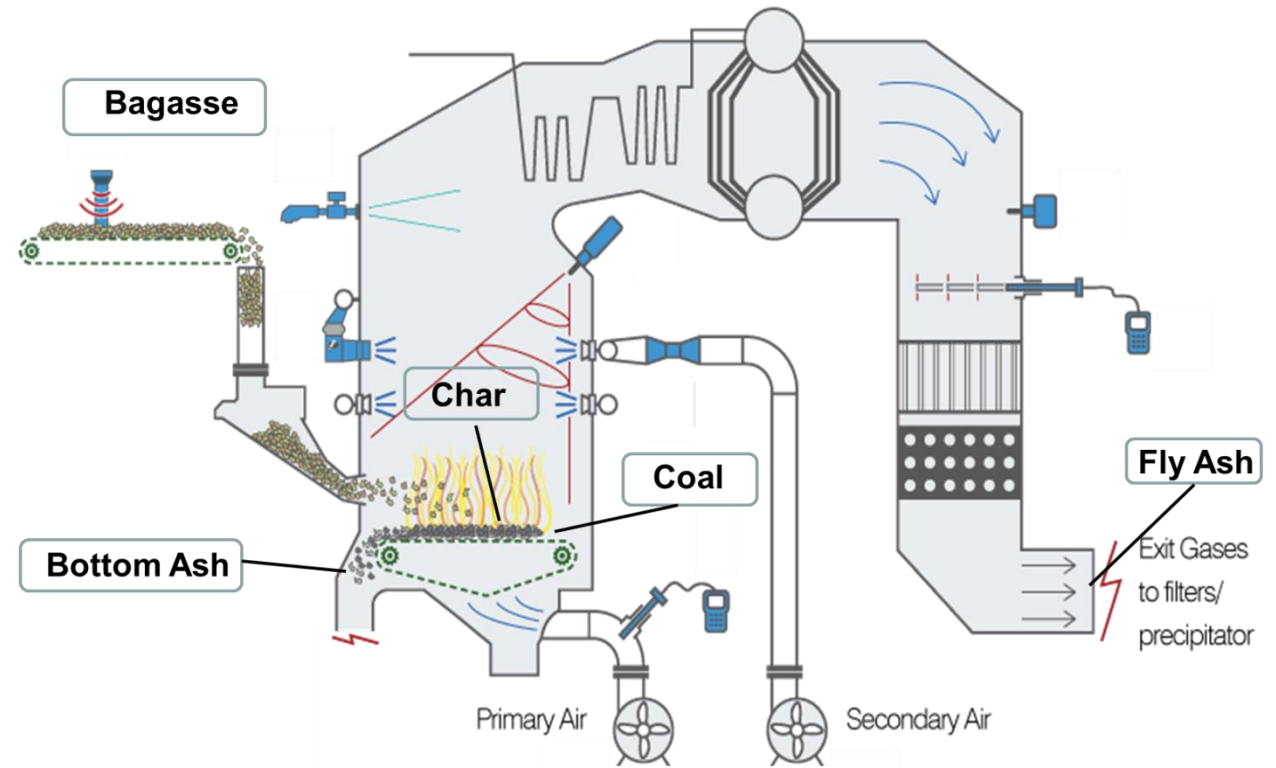
COLOMBIA:

- 13 Sugar Refineries
- Producing 5 Mton of **Bagasse** per year
- 85 % is used as **combustible** and 15% is used as raw material for pulp & paper industry
- Co-generation produce 237 MW of electric energy
- Coal-bagasse blends are fed to the industrial boilers at different proportion and size



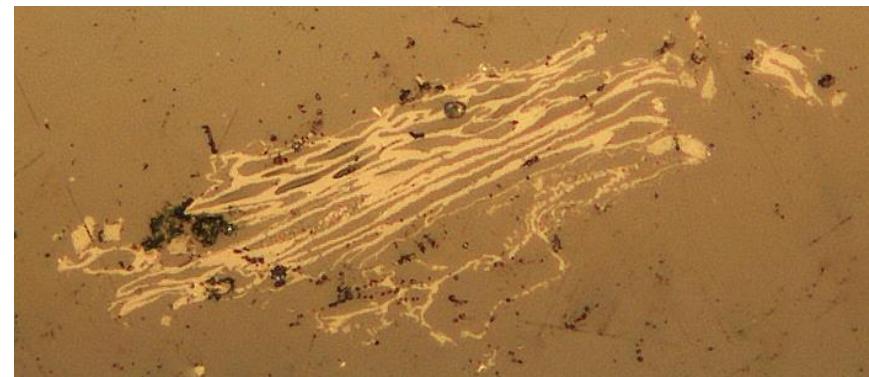
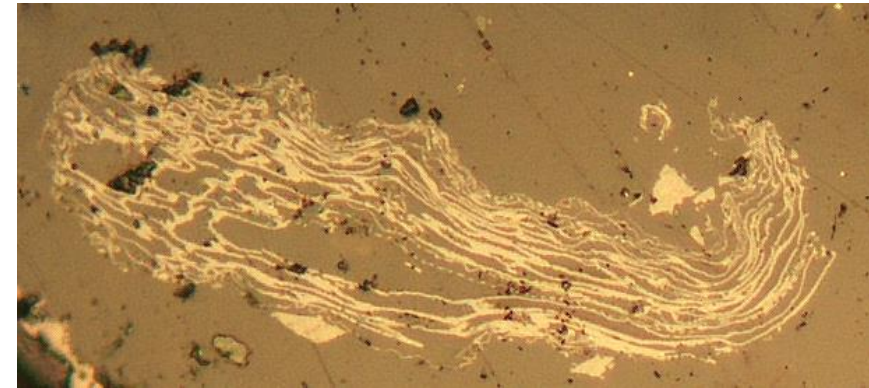
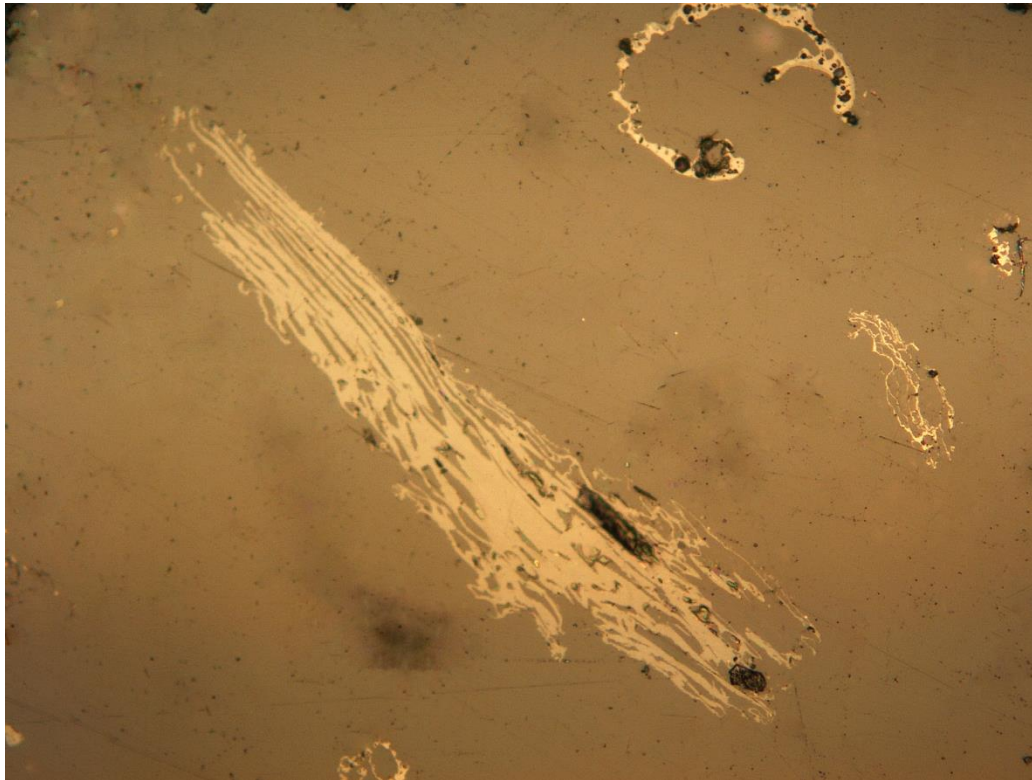
MOTIVATION

- High unburned coal LOI (>5%)
- Low Energy Efficiency in boilers using Coal biomass blends (70%)
- Relationship Char morphology- Reactivity
- Char Morphology classification for Biomass Chars
- Biomass combustion behavior



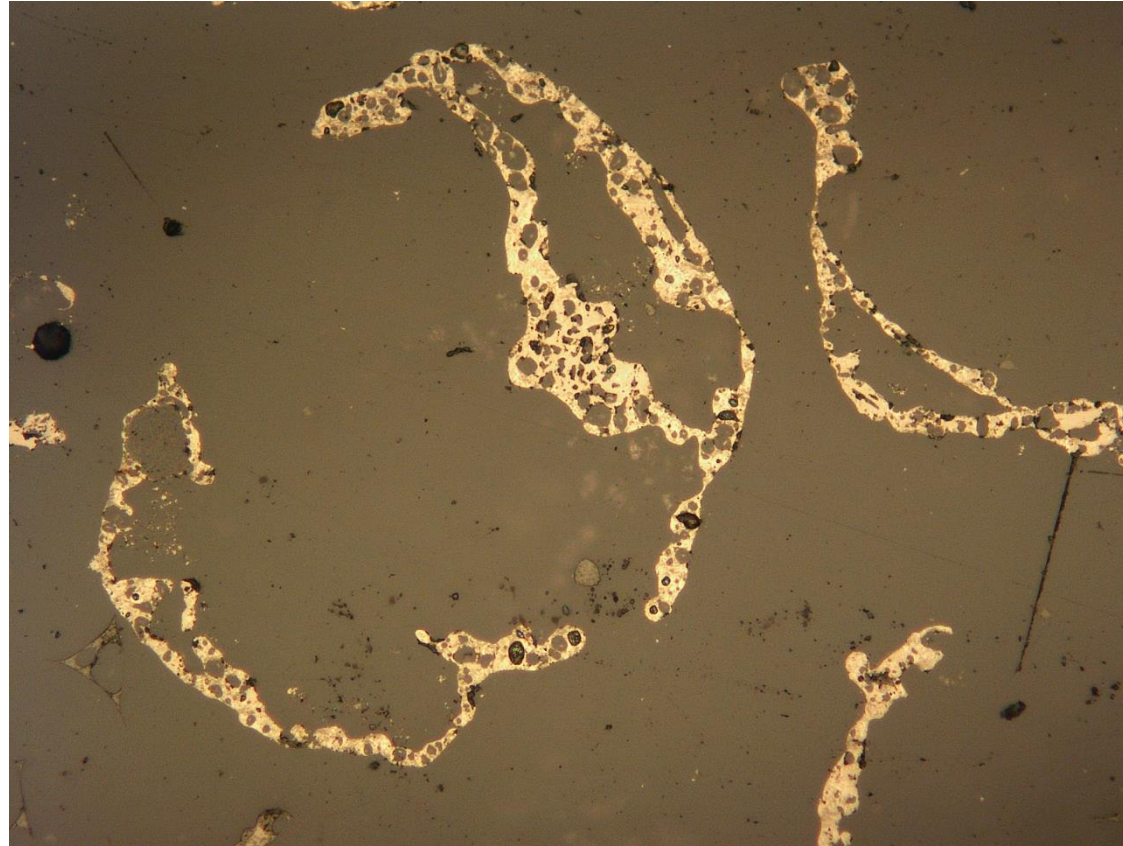
Typical stocker boiler used in sugar refineries

MOTIVATION



50X Biomass and coal chars

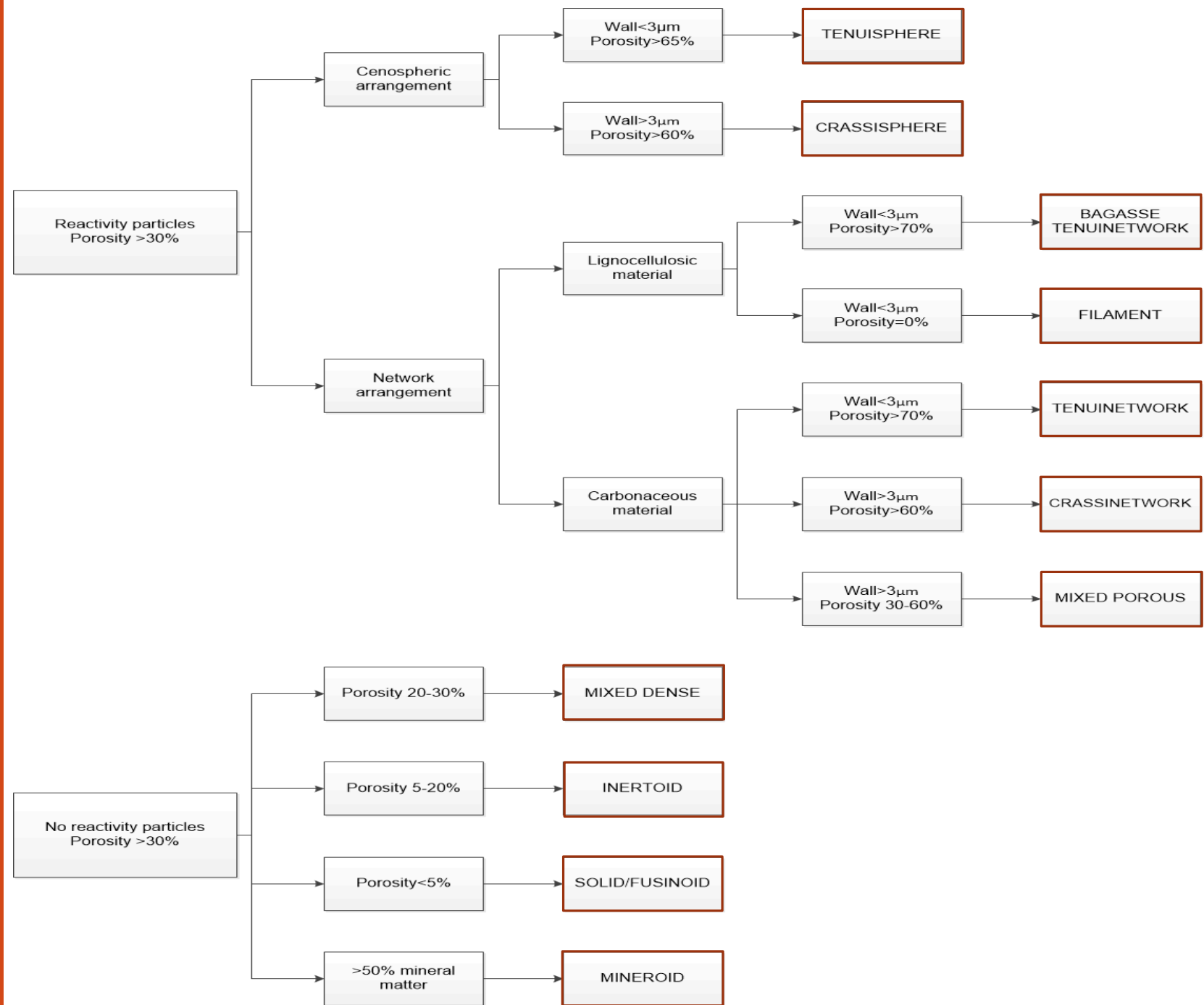
MOTIVATION



20X Coal chars

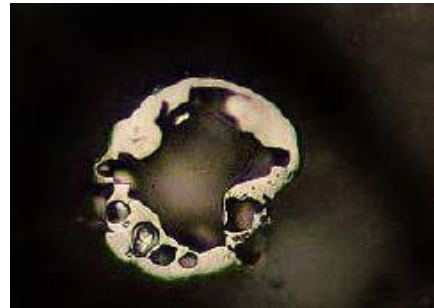
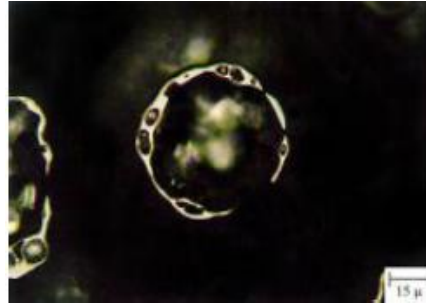
CHAR MORPHOLOGICAL CLASSIFICATION

[Castro & Sanabria 2015]



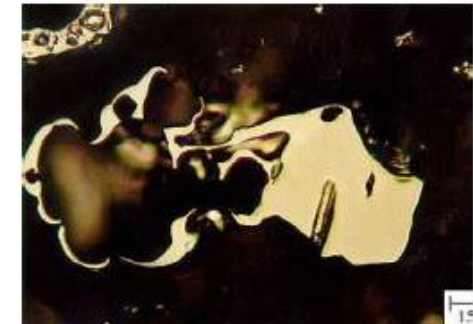
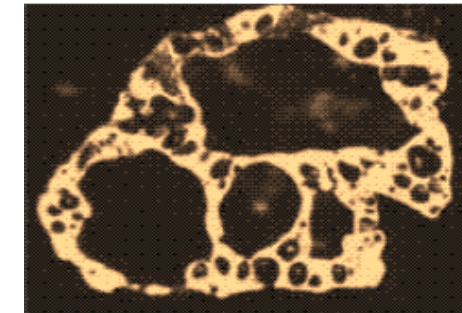
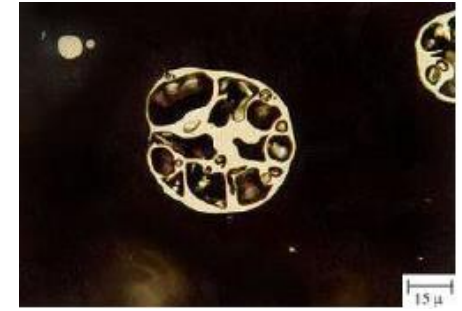
CHAR MORPHOLOGICAL CLASSIFICATION

Reactives



Sphere

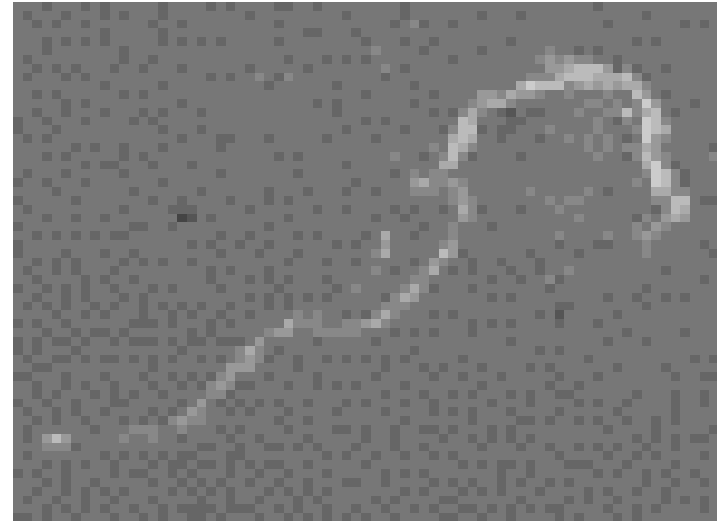
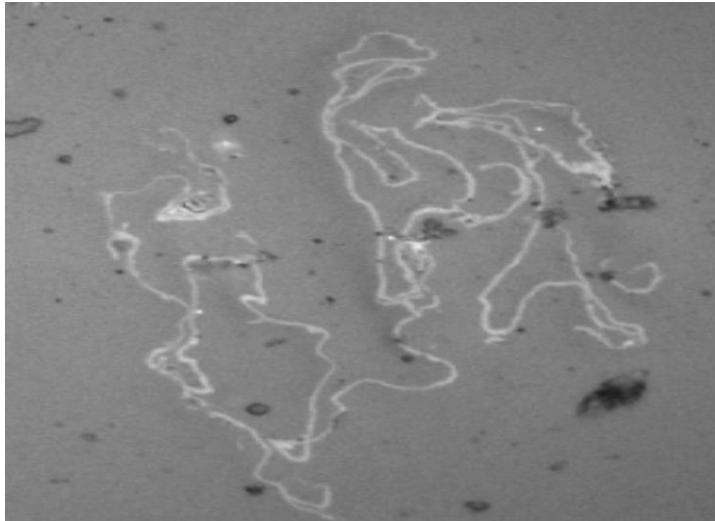
Moderately
reactive



Networks

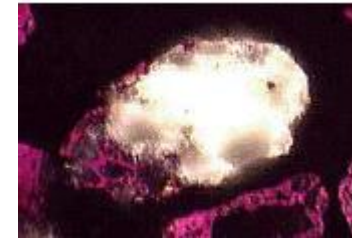
CHAR MORPHOLOGICAL CLASSIFICATION

Reactives



CHAR MORPHOLOGICAL CLASSIFICATION

Unreactives

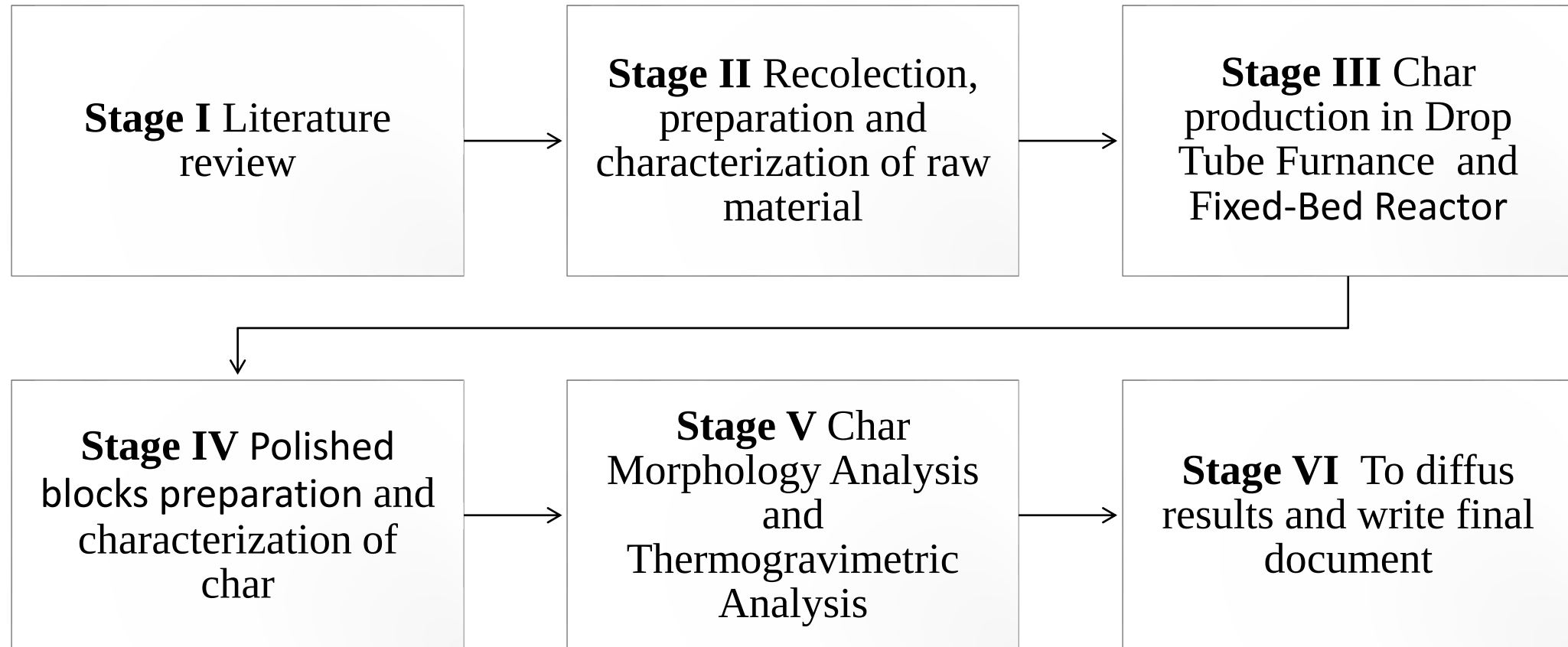


Solids

LOCAL BACKGROUND

- **Garcia 2013** Char Morphology from Colombian Coals and blends. (Antioquia, Valle, Cundinamarca)
- **Chaves 2013** software for char morphology classification using image classification analysis.
- **Sanabria and Castro 2015** char morphology classification of Bagasse and coal Blends (Valle)

MATERIAL AND METHODS



RESULTS

RAW MATERIAL

Analysis proximate, ultimate and calorific power

	Proximate analysis (%wt)				Ultimate analysis (%wt)					Calorific power (BTU/lb)
	Moisture	Volatile matter	Fixed carbon*	Ash	C	H	N	O*	S	
Coal	2,56	35,93	49,30	12,21	71,62	5,17	1,69	7,86	1,45	12670
Bagasse	5,68	64,89	6,45	22,99	31,18	5,28	0,53	40,0	0,03	5623

*calculated

RESULTS

ULTIMATE ANALYSIS AND CALORIFIC POWER

CHAR OBTAINED ON N₂ ATMOSPHERE

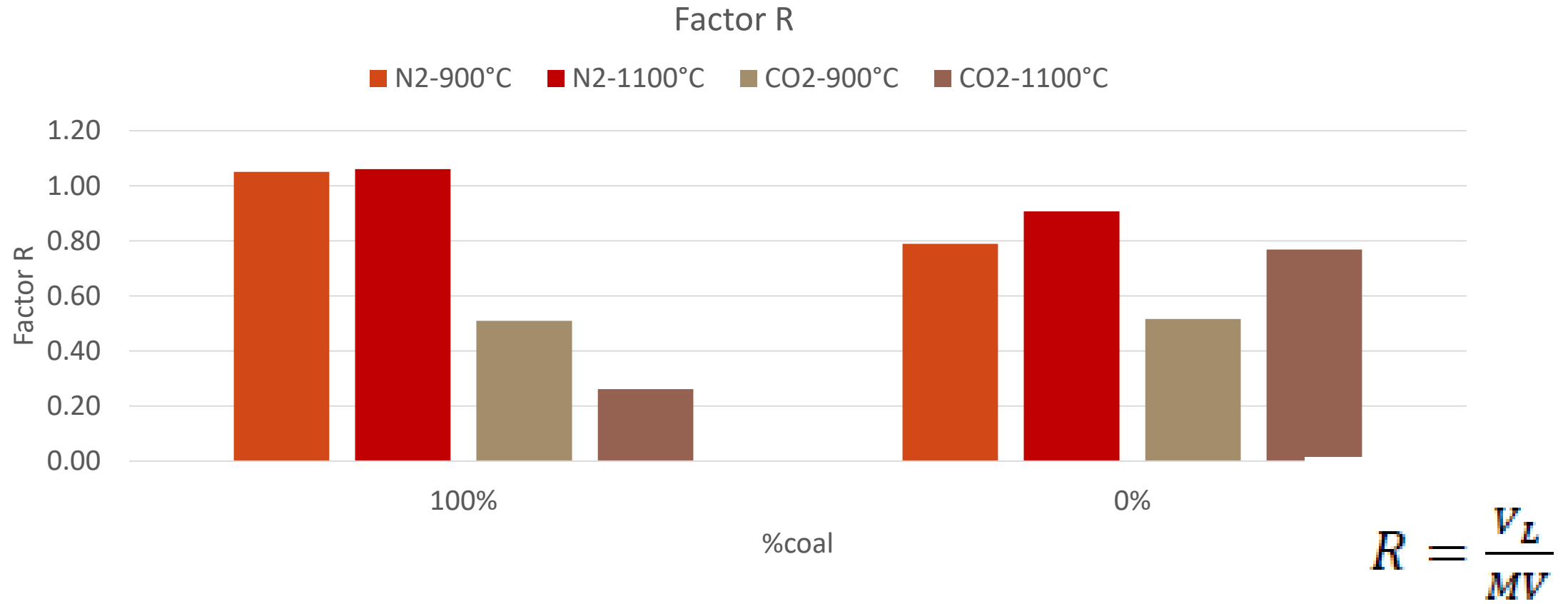
Coal (%wt)	Temperature (°C)	Ultimate Analysis (%wt)			Calorific power (BTU/lb)
		C	H	N	
100	900	70,09	3,07	1,28	11586
	1100	69,18	3,74	1,29	11502
0	900	26,78	3,58	0,27	7199
	1100	26,62	2,51	0,43	5479

CHAR OBTAINED ON CO₂ ATMOSPHERE

Coal (%wt)	Temperature (°C)	Ultimate Analysis (%wt)			Calorific power (BTU/lb)
		C	H	N	
100	900	72,86	4,31	1,38	12489
	1100	75,39	3,71	1,31	12546
0	900	37,09	4,17	0,32	7200
	1100	40,67	2,80	0,49	7110

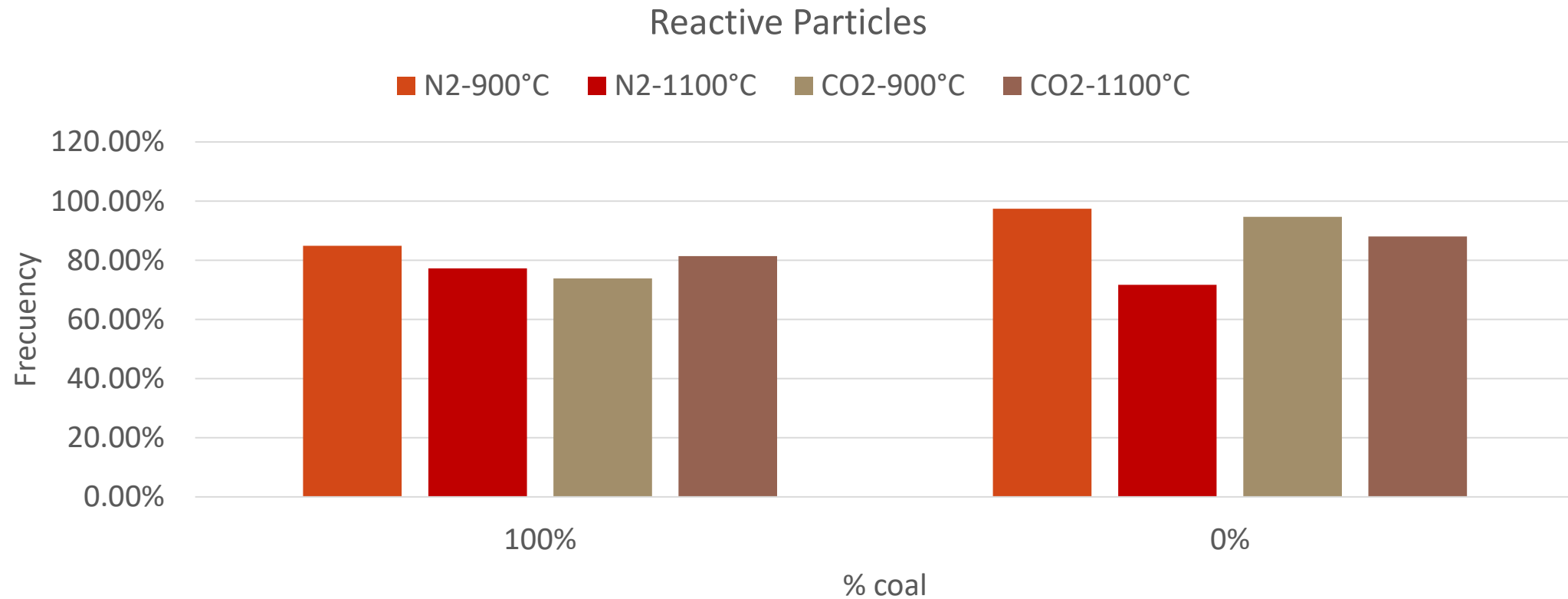
RESULTS

R FACTOR



RESULTS

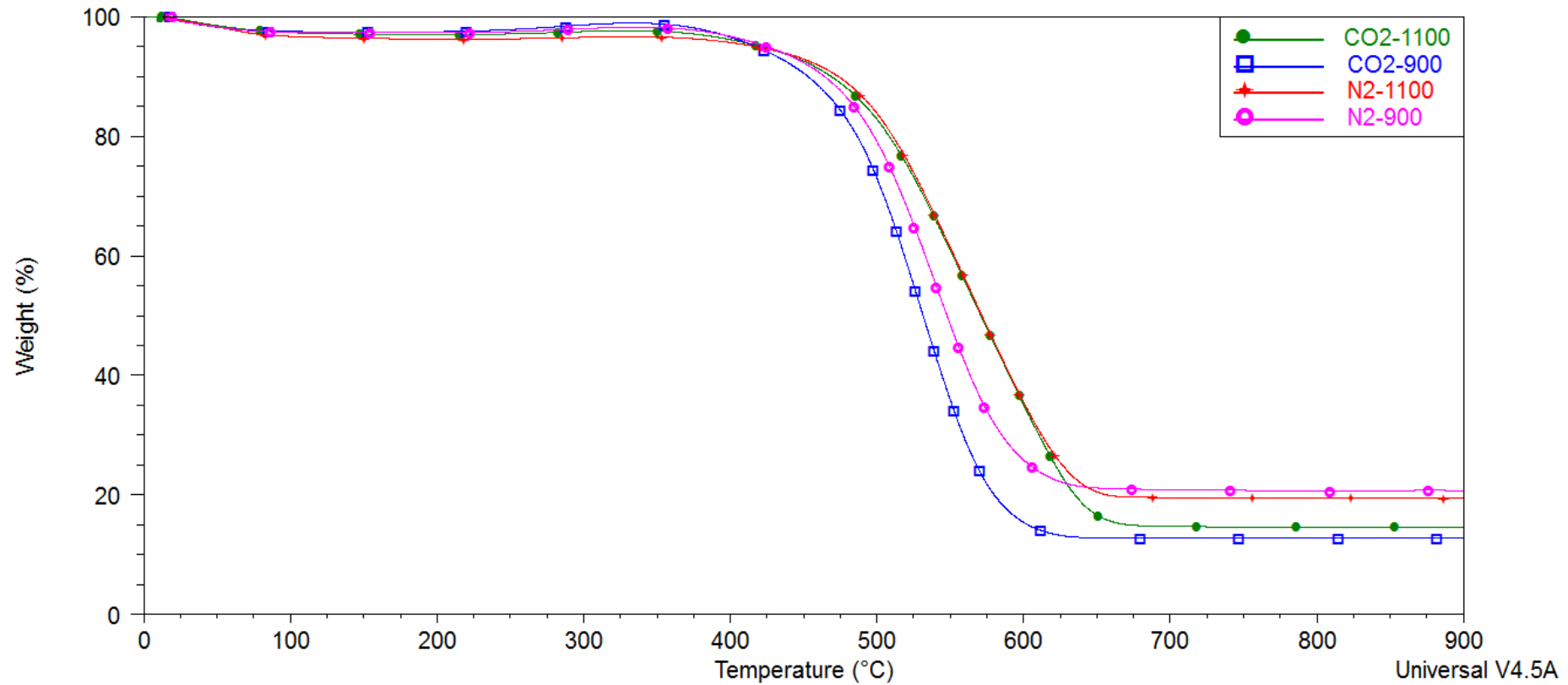
MORPHOLOGICAL CLASSIFICATION



RESULTS

THERMOGRAVIMETRIC ANALYSIS

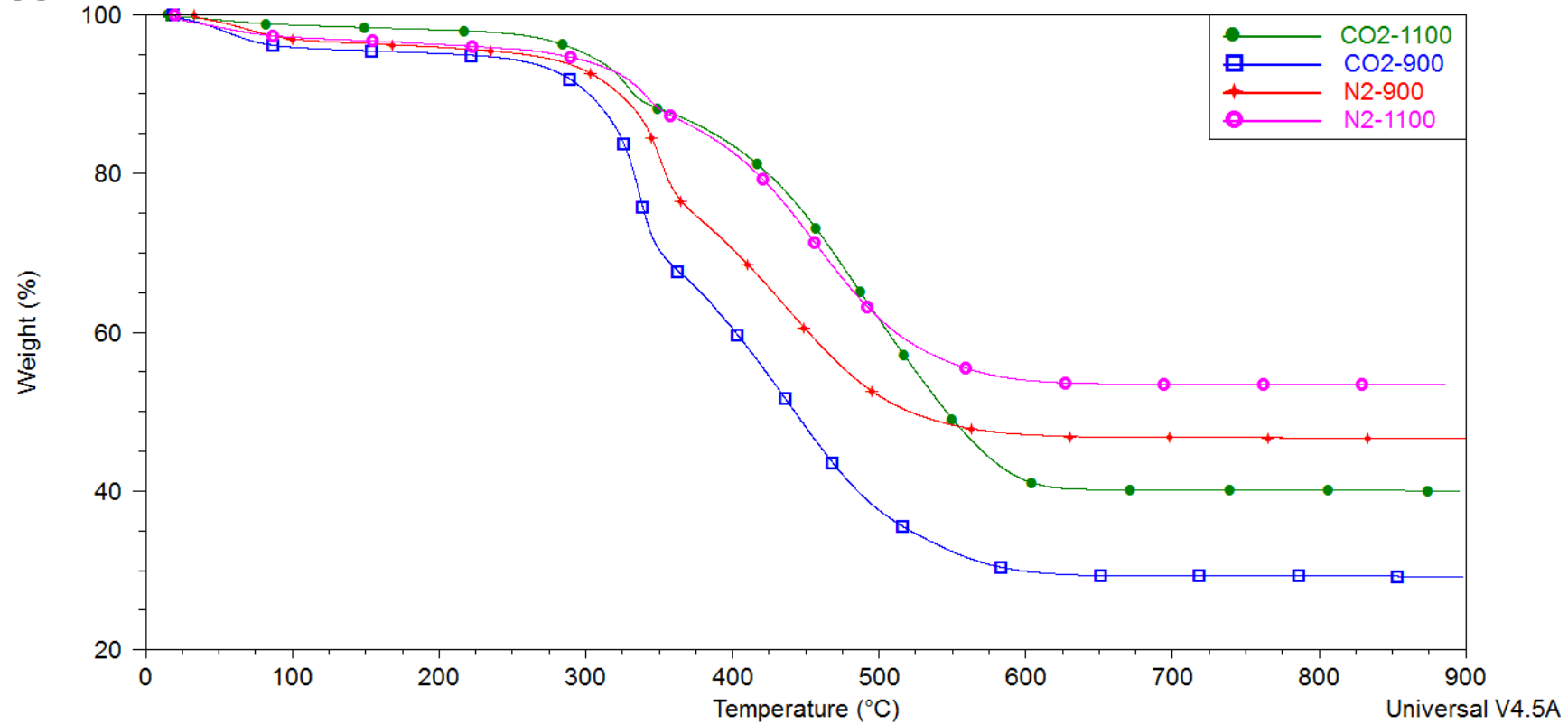
100% Coal



RESULTS

THERMOGRAVIMETRIC ANALYSIS

100% Baggasse



CONCLUSION

- ❖ CO₂ atmosphere does not represent an inert atmosphere for the pyrolysis, since it was evidenced changes in the structure of char , different from those produced in the N₂ atmosphere.
- ❖ High temperatures do not favour pyrolysis, since at this temperature, heavy compounds condense on char, causing their morphological characteristics to be less reactive.

Thank You for your
attention!
