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Universidade Federal de Viçosa

Departamento de Engenharia Civil

Engenharia Florestal
DEF-UFV

PORTLAND CEMENT PRODUCTION WITH DREGS AND GRITS FROM KRAFT PULP MILLS INCORPORATION TO THE CLINKER

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Academic Work

INTRODUCTION

It is estimated that in 2016 in Brazil were generated :

- **282,000 tons of Dregs**
- **94,000 tons of Grits**

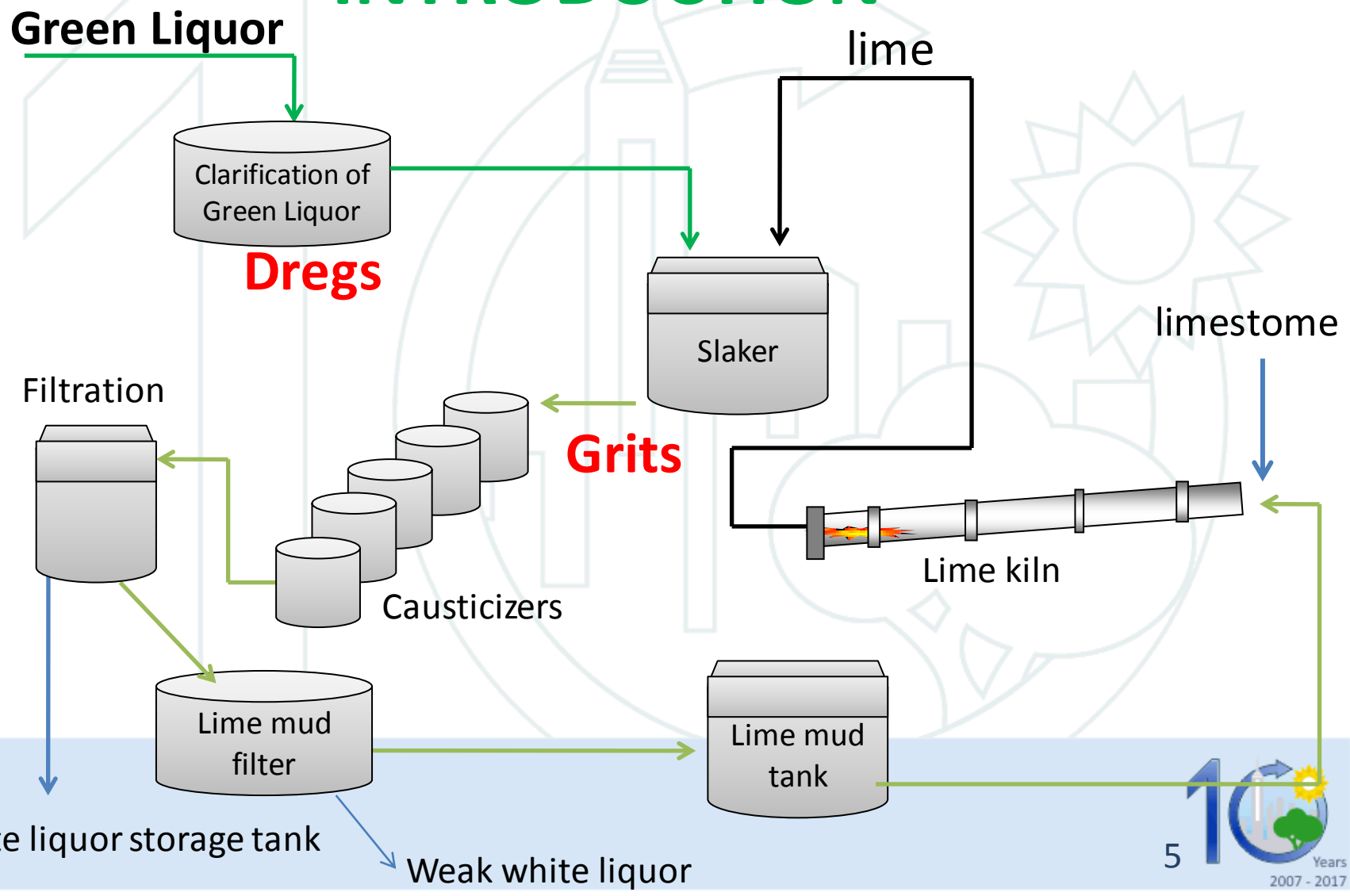
INTRODUCTION

Dregs, originated from green liquor clarification are impurities originating mainly from carbon, hydroxides and metal sulfides with pH approximately 11 and generated of up to 15 $kg.adt^{-1}$ of pulp produced

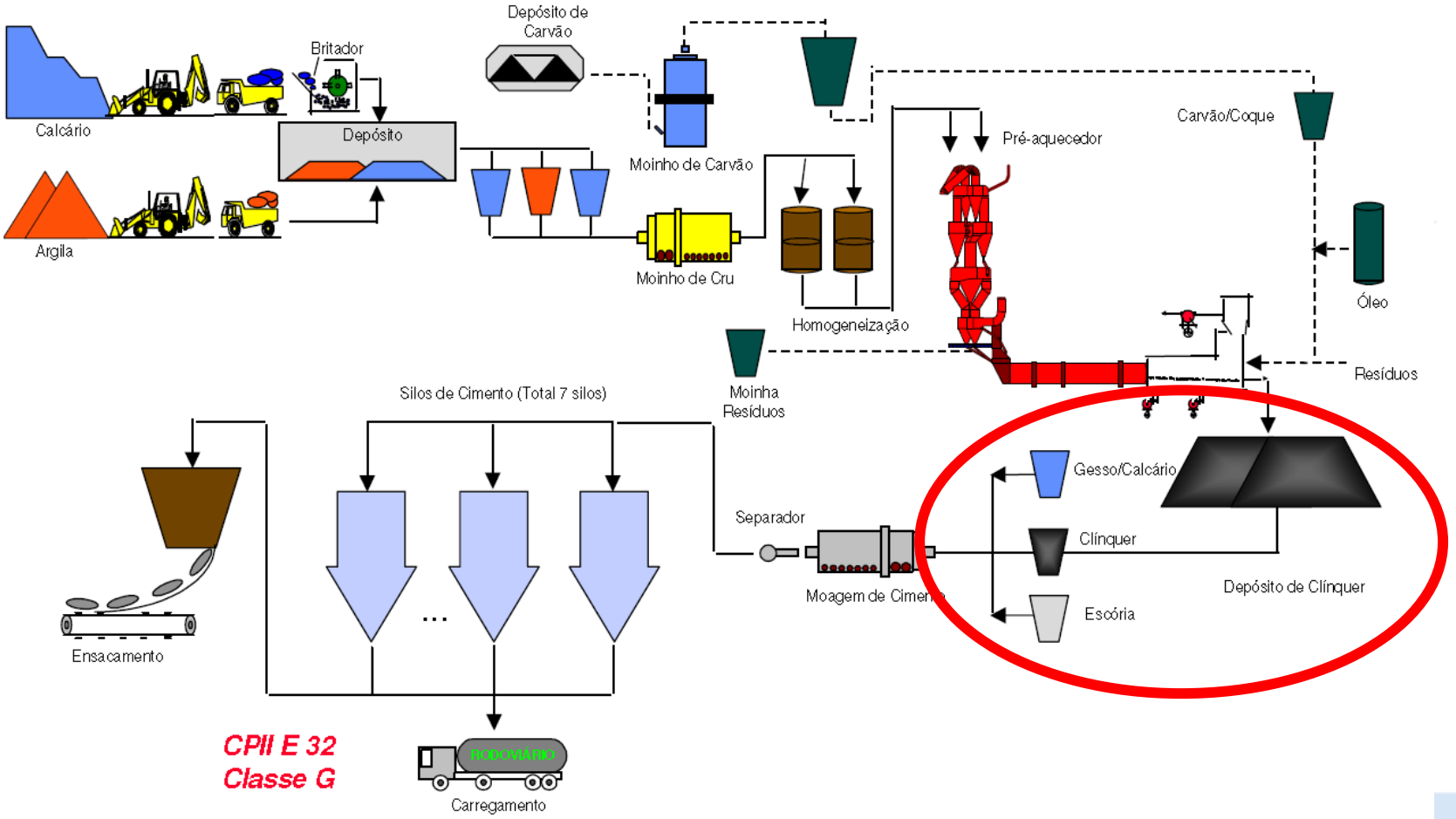
INTRODUCTION

Grits, originated in the slakers are composed of unreacted lime with pH approximately 11 and generation of up to 5 $kg.adt^{-1}$ of pulp produced

INTRODUCTION



INTRODUCTION



Source: PUC-RIO

INTRODUCTION

The Brazilian market has 8 cement options

The factors that differentiate the types of cement are the addition in the process of grinding different proportions of Clinker, calcium sulphates, carbonatic material and additions (slag, pozzolans and calcareous)

- Cimento Comum (CP I)
- Cimento Composto (CP II)
- Cimento de Alto-Forno (CP III)
- Cimento Pozolânico (CP IV)
- Cimento de Alta Resistência Inicial (CP V-ARI)
- Cimento Resistente a Sulfatos (RS)
- Cimento de Baixo Calor de Hidratação (BC)
- Cimento Portland Branco (CPB)

OBJECTIVES

This paper proposes the incorporation, in different proportions (2.5; 5; 7.5; 10 and 15%), of alkaline solid wastes from pulp mills, namely **dregs** and **grits**, to clinker in the cement industry

MATERIAL AND METHODS

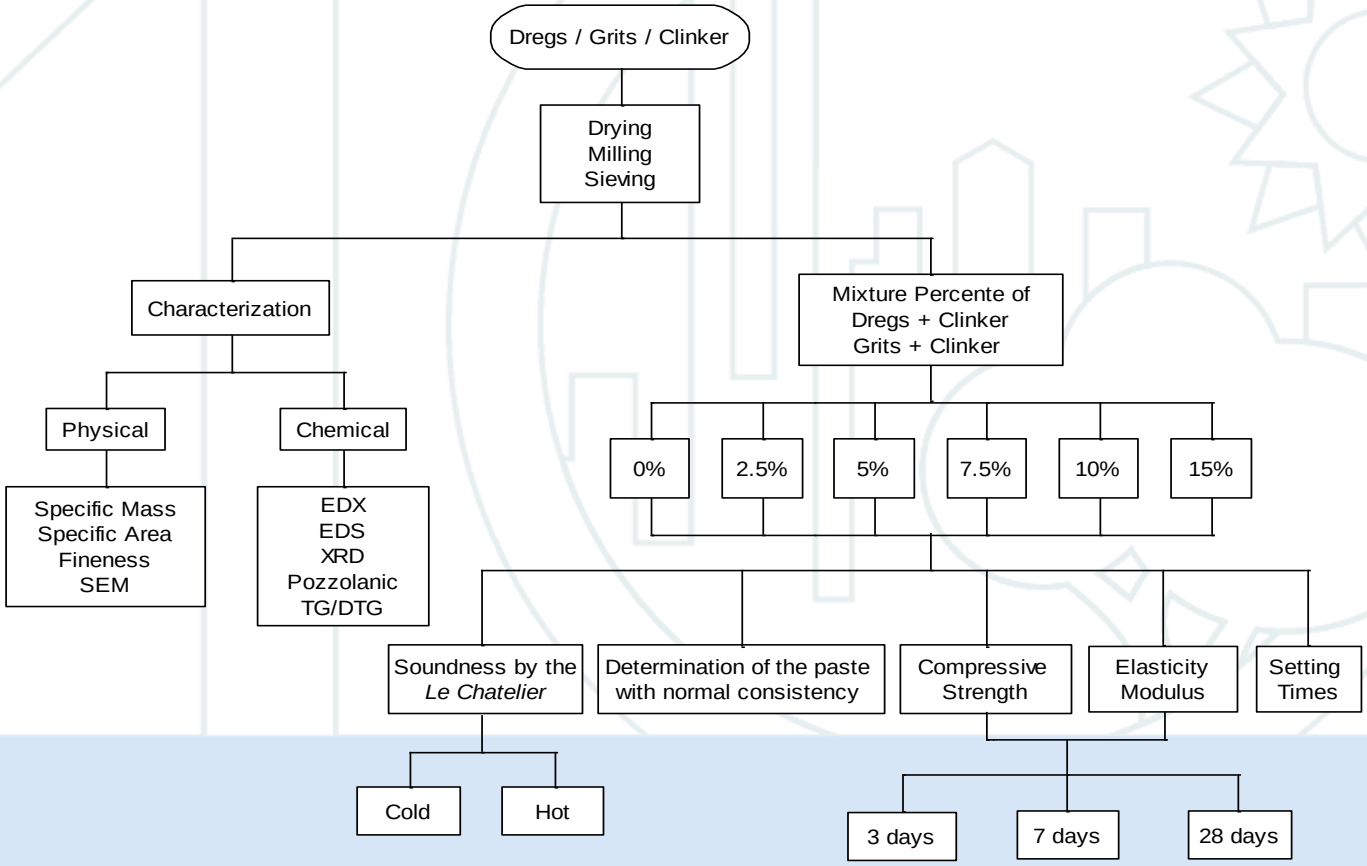
Dregs and grits were obtained from a Brazilian bleached kraft pulp mill

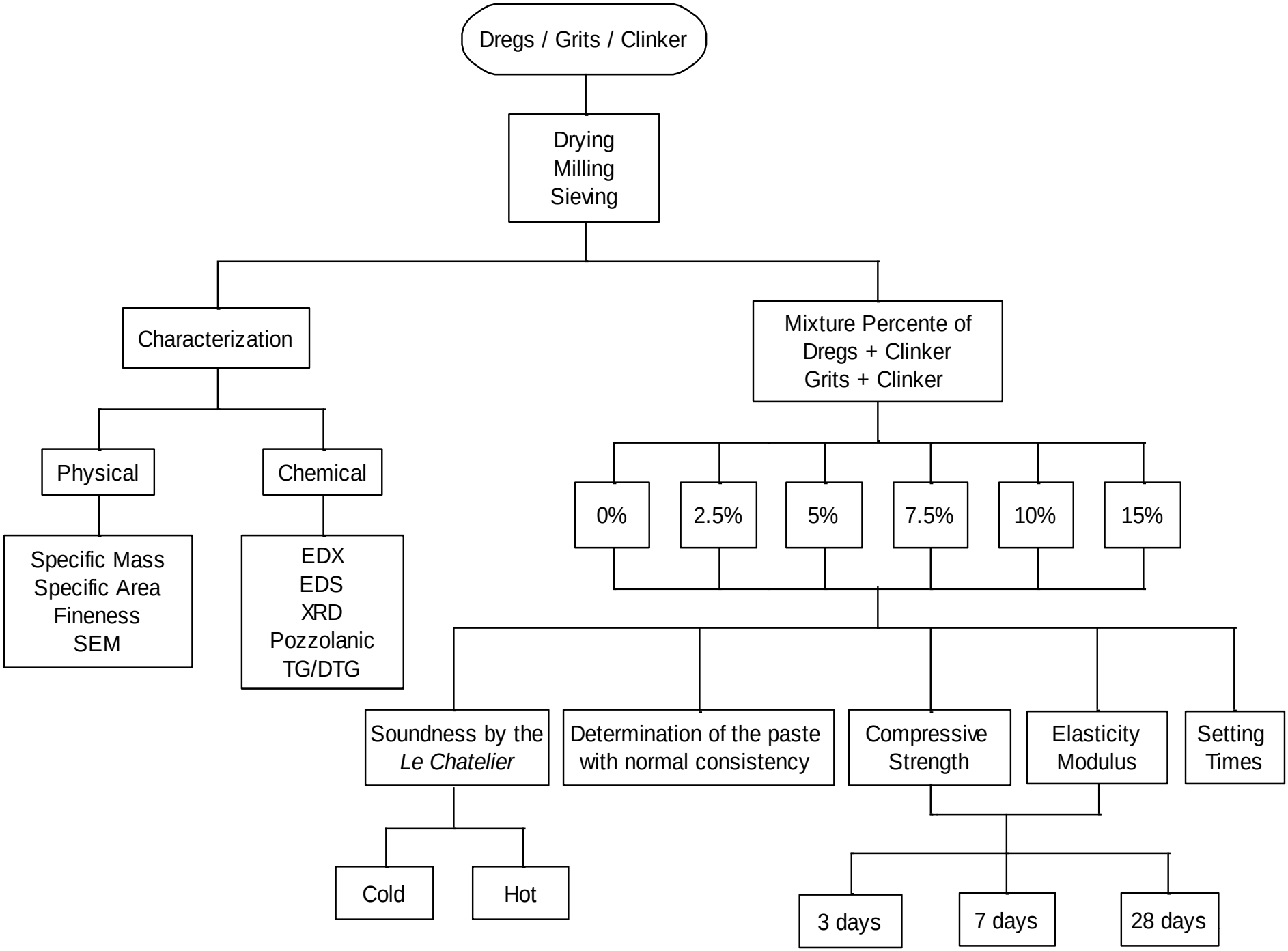
Clinker was obtained from a Brazilian cement

These materials were characterized in the laboratories of the Federal University of Vicosa – UFV and the Federal University of Minas Gerais – UFMG

MATERIAL AND METHODS

The dregs and grits were submitted to an experimental path described by the flowchart




Dregs / Grits / Clinker
Drying
Milling
Sieving
Characterization
Mixture Percente of
Dregs + Clinker
Grits + Clinker
Physical
Chemical
Specific Mass
Specific Area
Fineness
SEM
EDX
EDS
XRD
Pozzolanic
TG/DTG
0%
2.5%
5%
7.5%
10%
15%
Soundness by the
Le Chatelier
Determination of the paste
with normal consistency
Compressive
Strength
Elasticity
Modulus
Setting
Times
Cold
Hot
3 days
7 days
28 days

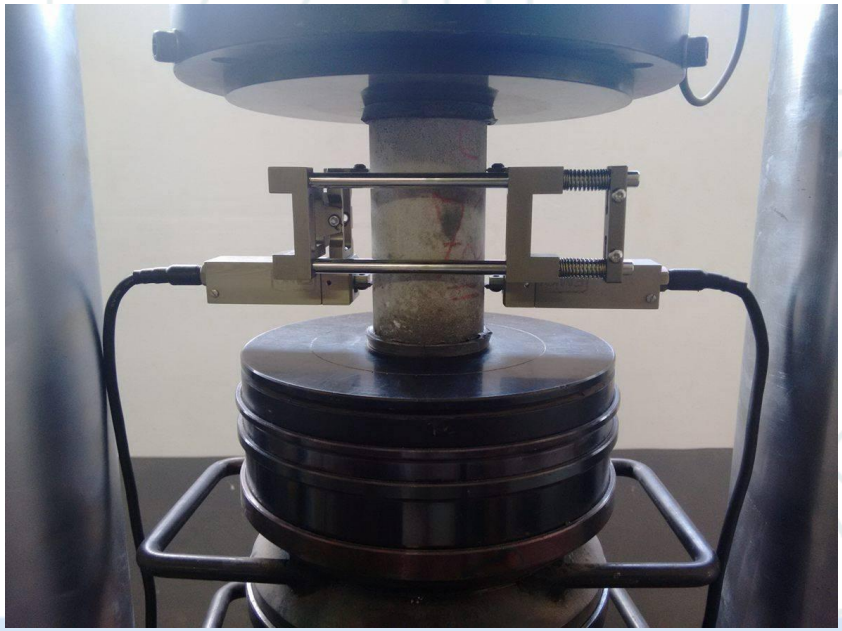
In the present research for each incorporation of dregs and grits (2.5; 5; 7.5; 10 e 15%) to the clinker

Dosage materials for experimental clinker

Samples	Series	Trace (%)		Amount of specimens	
		Cliker	Dose	Compressive strength	Elasticity modulus
	CPo - 0	100	0	12	9
Dregs	CPd - 2.5	97.5	2.5	12	9
	CPd - 5.0	95.0	5.0	12	9
	CPd - 7.5	92.5	7.5	12	9
	CPd - 10.0	90.0	10.0	12	9
	CPd - 15.0	85.0	15.0	12	9
Grits	CPg - 2.5	97.5	2.5	12	9
	CPg - 5.0	95.0	5.0	12	9
	CPg - 7.5	92.5	7.5	12	9
	CPg - 10.0	90.0	10.0	12	9
	CPg - 15.0	85.0	15.0	12	9
Total				**132**	**99**

MATERIAL AND METHODS

For each dose, four specimens were tested in each age (3, 7 and 28 days). The elasticity modulus test was carried out only in the last three specimens.

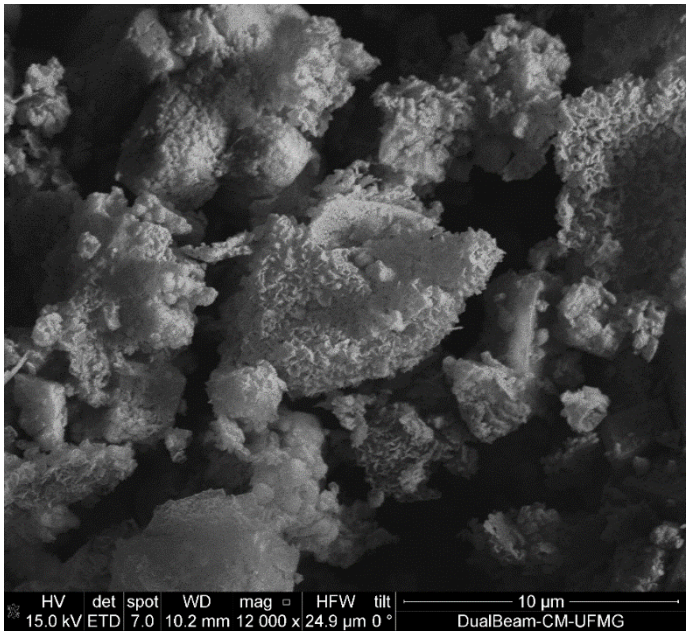


The used universal testing machine was a EMIC, model DL600KN
compressive strength and elasticity modulus

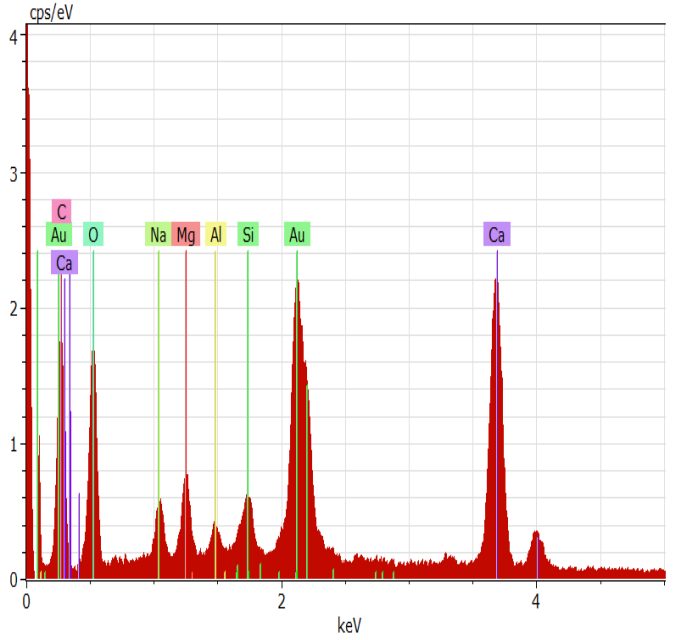
RESULTS AND DISCUSSION

EDX of clinker, dregs and grits

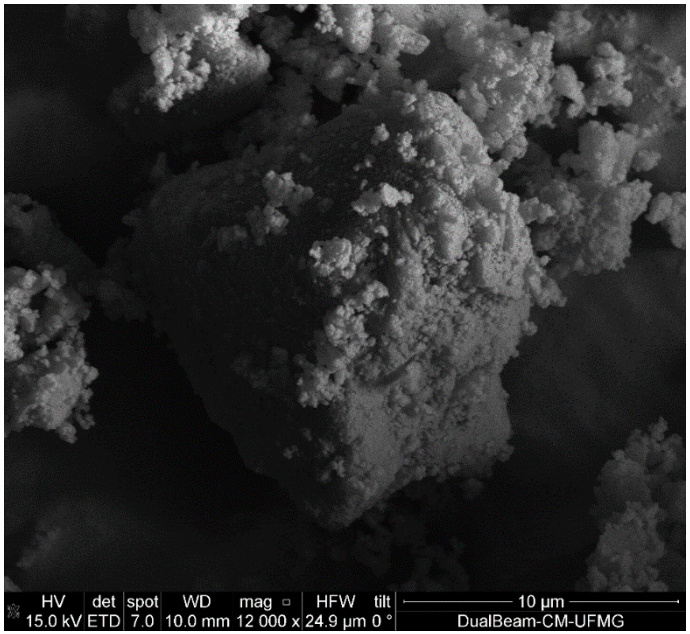
	CaO	SiO_2	Al_2O_3	Fe_2O_3	SO_3	MgO	K_2O	Na_2O	TiO_2	Cl	Others
Clinker (%)	**64.55**	20.65	3.02	3.23	1.00	0.33	1.47	1.71	0.27	0.07	3.72
Dregs (%)	**68.85**	6.67	0.74	3.27	6.44	3.14	**0.91**	**3.64**	0.18	0.39	5.78
Grits (%)	**83.36**	5.21	0.29	1.16	0.97	0.66	**0.50**	**2.77**	0.08	0.27	4.73



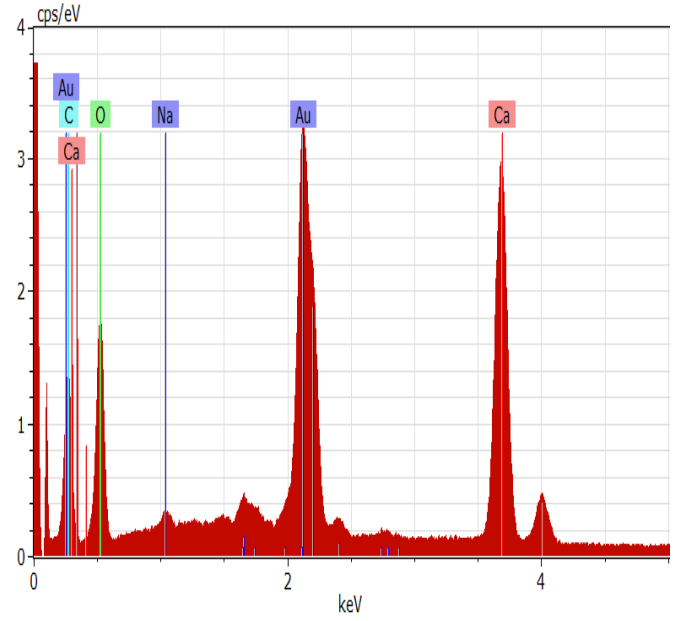
SEM Dregs



EDS Dregs



SEM Grits



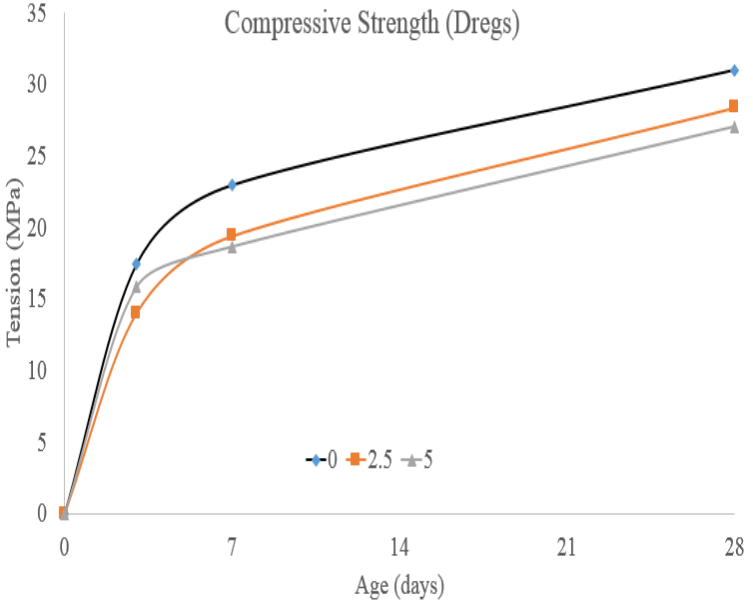
EDS Grits

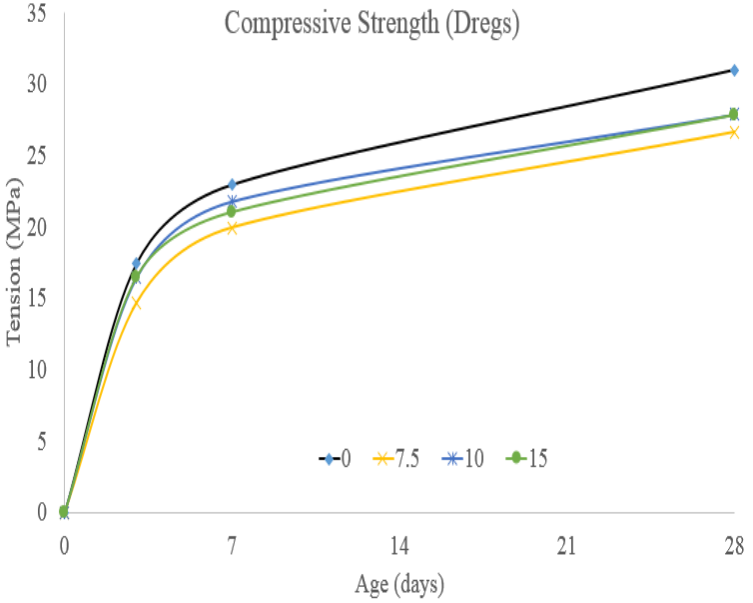
Results of material characterization tests

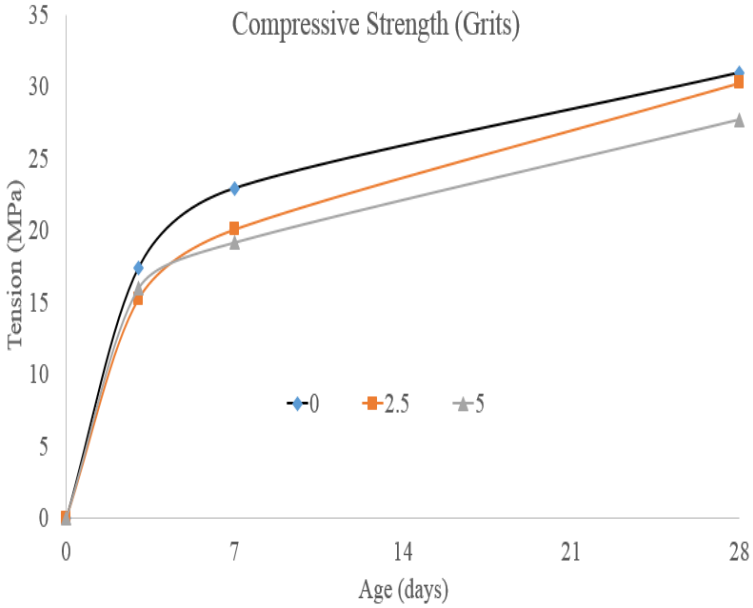
Tests		Normal Consistency (A(%))	Setting Times (h:min)		Soundness by the *Le Chatelier* (mm)	
			Stard	End	Hot	Cold
Clinker		30.88	1:45	2:40	0	0.27
2.5%	*Dregs*	---	1:55	2:47	0	0
	Grits	---	1:15	2:15	0	0
5.0%	*Dregs*	---	1:20	2:25	0	0
	Grits	---	1:30	2:45	0	0
7.5%	*Dregs*	---	1:11	2:43	0	0
	Grits	---	1:40	3:26	0	0
10.0%	*Dregs*	---	1:16	2:37	0	0
	Grits	---	1:24	2:56	0	0
15.0%	*Dregs*	---	**0:32**	3:10	0	0
	Grits	---	**0:55**	2:42	0	0
Limits		---	≥ 1h	≤ 10hs	≤ 5	≤ 5

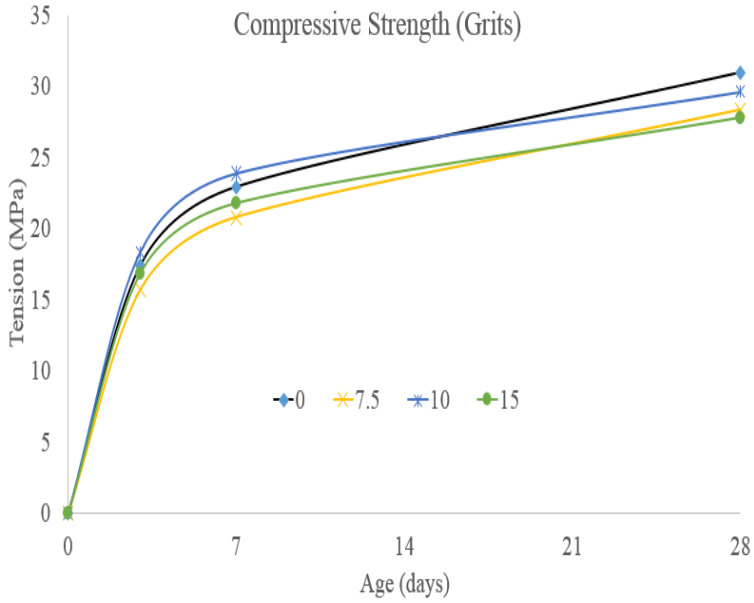
Tests		Specific mass (g/cm³)	Specific Area (m²/kg)	Fineness (%)	Pozzolanic (mS/cm)
Clinker		3.00	246	0.26	0.98
Dregs		2.44	**1031**	0.78	0.87
Grits		2.67	**972**	**95.20**	0.31
2.5%	*Dregs*	2.94	282	0.22	---
	Grits	3.05	325	1.28	---
5.0%	*Dregs*	2.99	315	0.28	---
	Grits	3.01	306	2.46	---
7.5%	*Dregs*	2.93	307	1.00	---
	Grits	2.99	301	5.36	---
10.0%	*Dregs*	2.87	335	0.54	---
	Grits	3.00	361	2.72	---
15.0%	*Dregs*	2.98	404	0.44	---
	Grits	2.95	352	3.96	---
Limits		---	≥ 245	≤ 12	---

The results of the **COMPRESSIVE STRENGTH TESTS** on four of the percentages **Dregs and Grits** 3, 7 and 28 days of age

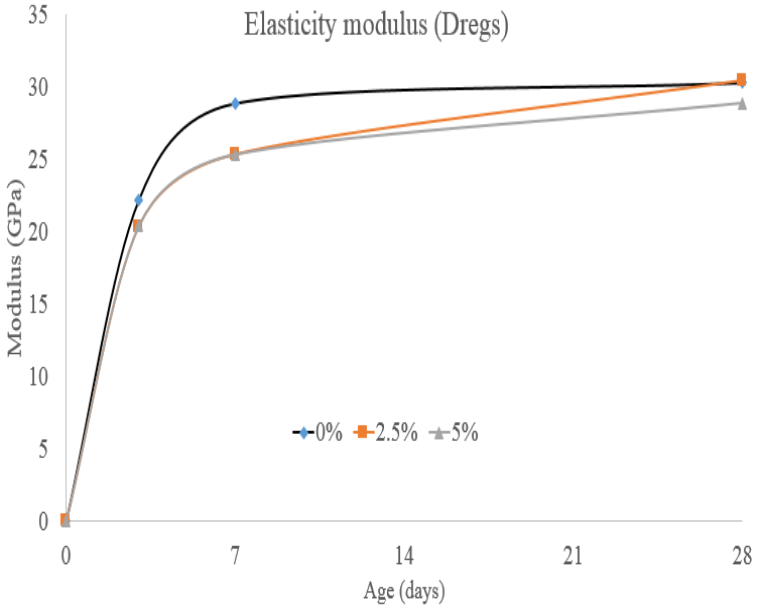


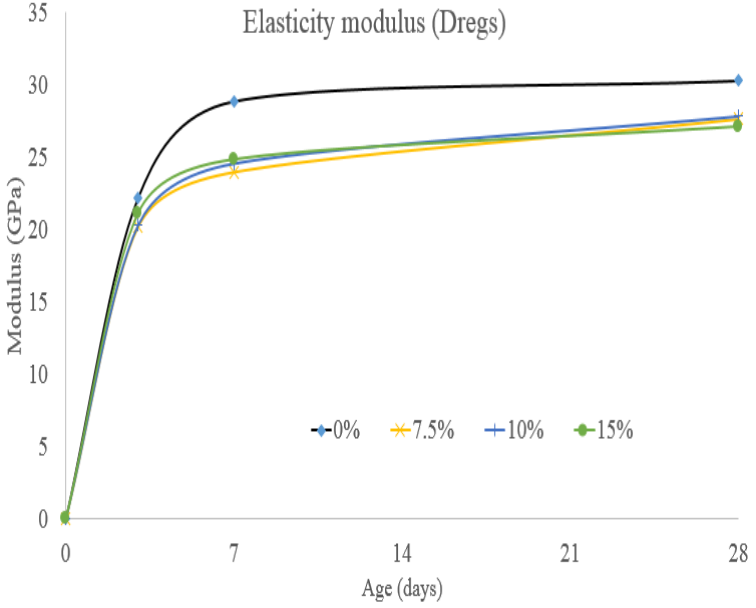


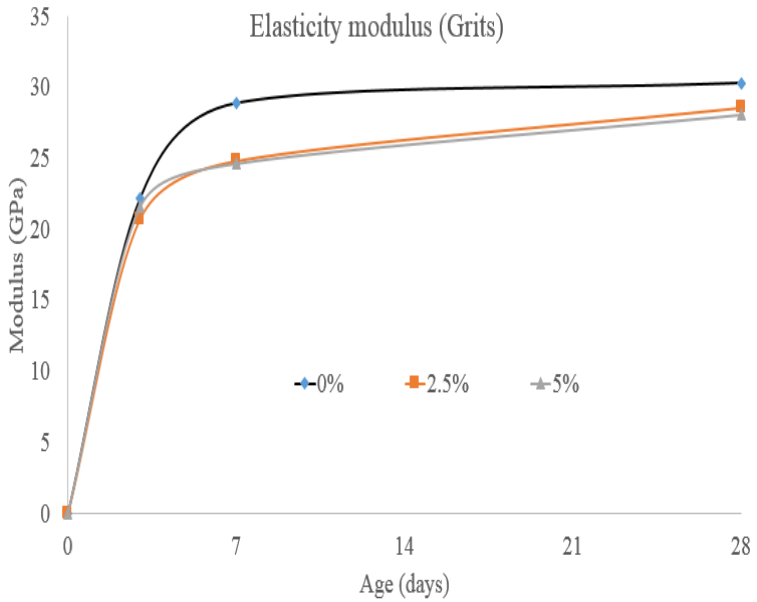


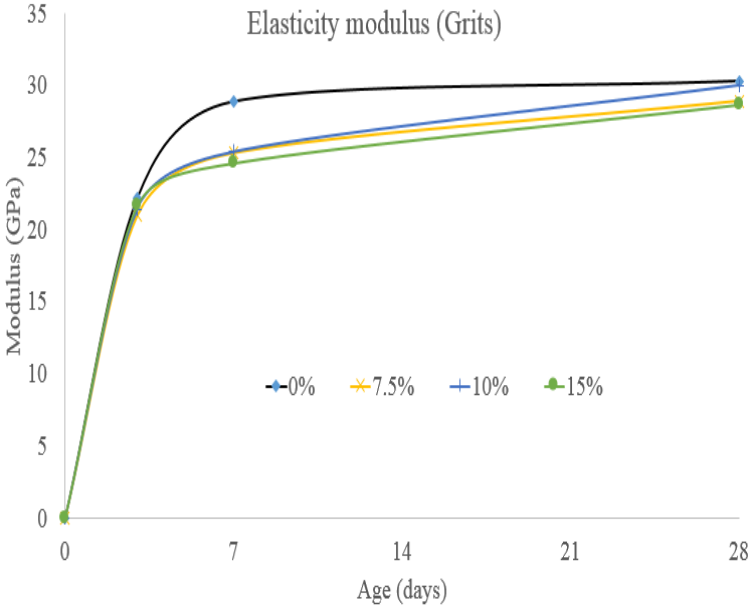


The results of the **ELASTICITY MODULUS TESTS** on four of the percentages **Dregs and Grits** 3, 7 and 28 days of age









CONCLUSIONS

The physical-chemical characterization of dregs and grits showed a great potential to use these materials for incorporation into the clinker Portland cement production

The different incorporation of dregs and grits (2.5; 5.0; 7.5 and 10%) to the clinker proved viable for ordinary Portland cement production with addition (CP I-S) and Portland composite cement (CP II-F)

CONCLUSIONS

The incorporation of both materials to clinker fulfilled the minimum limits for the compressive strength test and modulus of elasticity established by the Brazilian standard

Grits showed, in general, better results than Dregs

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Questions?
Thank you!

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