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With the contribution of the LIFE financial instrument of the European Community

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SE.TE.C. Group

SETEC GROUP

SETEC Sanitary-ware division

VICENTINI Table-ware division

IPEG Kilns division

SE.TE.C. GROUP is one of the world leaders in service and technology for the production of sanitary-ware & table-ware. It has done business in the ceramic sector for over 20 years. Its customers include some of the most well known producers of sanitary-ware and table-ware in the world.

SE.TE.C. head quarter is located in Civita Castellana (VT) Italy

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PROJECT OBJECTIVES

Use of waste glass in ceramic Sanitaryware Formulation

Reduction of industrial production costs

- Reduction of virgin raw materials
- Reduction of firing temp. of 80-100°C.

Reduction of environmental impact

- Recycling of urban waste
- CO_2 emission reduction

SAVING OF ENERGY

Standard firing temperatures for Vitreous China Sanitaryware are between 1230 °C and 1250 °C with firing cycles around 14-16 h. The formulation studied in the SANITSER project will make possible to realize firing cycle with temperatures between 1150 °C and 1190 °C with the intention to reduce also the stay time at Max. temperature with an estimated save of thermal energy of about 18%

-18%

SAVING OF NATURAL RESOURCES

In the studied formulation of bodies and glazes it will be used a significant part of recycled glass, granite and Vitreous China scraps in order to reduce the total consumption of natural raw materials up to about 40%

-40%

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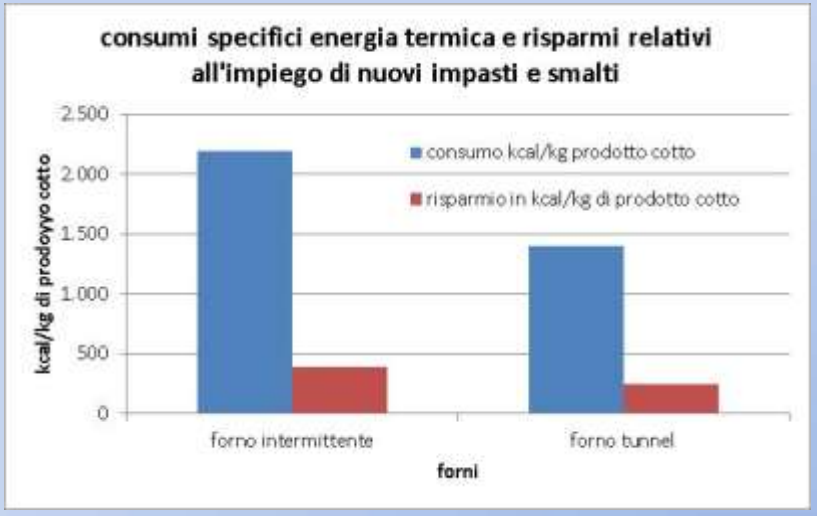
ENERGY SAVING ECONAMICAL BENEFIT

Type of Kiln	Medium n° of fired pieces per day	Consumption of energy for each Kg of fired product in Kcal	Energy saving of 18% (in Kcal for each Kg of fired product)	Energy saving in Kcal per day (Considering medium weigh of one ceramic article of 20 Kg)	Energy saving in Nm^3 Methane per day	Energy Saving in €/day (Considering methane cost 0,35 €/Nm^3)
Shuttle	400	2100-2300	≈ 396	3.168.000	386,3	135,1
Tunnel	1000	1200-1600	≈ 252	5.040.000	614,6	215,1

Lower calorific Value of methane: 8200 kcal/Nm^3



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ENERGY SAVING
ENVIRONMENTAL BENEFIT

Decrease of firing temperature of (about 80-100°C) makes possible a significant reduction of gas emissions form the kilns during firing process.

Type of kiln	Saving of Nm^3 of methane per day	Saving of Nm^3 of methane per year	Reduction of emission of CO_2 in Kg/year
Shuttle (400 pcs/day)	**386,3**	**84.986** (Considering 220 working days / year	**169.972**
Tunnel (1000 pcs/day)	**614,6**	**202.818** Considering 330 working days / year)	**405.636**

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ENERGY SAVING
GENERAL CONSIDERATION

Today in Italy are manufactured about 4,5 millions of sanitary ware per year and in Europe (including Turkey) the production is of about 50 millions pcs.

Country	Million of pcs./year [A]	Ton of fired product per year	Energy saved in Kcal/year [B]	Energy Saved in Nm^3 / year of Methane	Saving of CO_2 emission in Kg/year	Corresponding reduction of cars on the road / year [C]
Italy	4,5	90.000	29.070.000	3.545.000	7.090.000	1969
Europe	50,0	1.000.000	323.000.000	39.390.243	78.780.488	21.883

[A] data obtained by ACIMAC
[B] it is assumed a weighed average of the different kind of kilns of 1749 Kcal/kg, with a medium saving of 323 kcal/kg
[C] cars produce an average of 180 g/km of CO_2 considering annual average distance of 20.000 km.

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Vitreous China Body Formulations

SANITSER 1, 5, 7

Raw material	SANITSER 1 (%)	SANITSER 5 (%)	SANITSER 7 (%)
Ball clays	24	24	24
Kaolin	30	30	30
Glass filler "GS-VF (Recovery glass)	10	12	9.5
Pitcher "BVC-VF (V.C. grinded scraps)	8 **28 %**	8 **41 %**	8 **35.62%**
Feldspar "F60-PBVF (Recovery granite)	10	21	18.12
Quartz	18	5	/
Talc	/	/	2.38
Pegmatite Flos 7	/	/	8

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Rehological Characteristics

SANITSER 1, 5, 7

Rheological characteristics	Standard Vitreous China	SANITSER 1	SANITSER 5	SANITSER 7
Specific Weight	1800	1805	1806	1809
Water (%)(added to the body)	32	35	35	30
Viscosity	305	295	300	302
Thixotropy	32	35	38	30
Sodium silicate (%)	0.165	0.140	0.150	0.100
Sodium carbonate (%)	0.07	0.07	0.07	0.07
Barium carbonate (%)	0.05	0.05	0.05	0.05

The new bodies show rheological characteristics similar to the standard but with lower concentration of required sodium silicate especially in body n° 7

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Greification Curves

SANITSER 1, 5, 7

1. The Greification curves are obtained reporting the total shrinkage (%) and the water absorption (%) of the ceramic mass as a function of firing temperature.
2. The aim of these first tests is to obtain new formulation with an optimal range of firing temperatures in the range 1160 and 1180° C.

Parameter	Standard Vitreous China
Total shrinkage (%)	11.0-12.5
Water absorption (%)	< 0.5

Shrinkage (%)

Temperature (°C)	SANITSER 1	SANITSER 5	SANITSER 7
1160	10.28	**11.08**	**11.06**
1180	10.65	**11.28**	**12.01**

Water abs. (%)

Temperature (°C)	SANITSER 1	SANITSER 5	SANITSER 7
1160	3.07	1.39	**0.45**
1180	2.69	**0.34**	**0.17**

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Characterization of SANITSER 7

Characteristic	SANITSER 7	STANDARD V.C.
Resistance to bending (kgf/cm^2)	24.29	24
Thickness in 60 minutes (mm)	6.8	6.9
Thickness in 90 minutes (mm)	8.3	8.5
Deformation (mm)	46	43

SCHEDA TECNICA
IMPASTO

CODICE	CLIENTE-NAZIONE	DATA
VC – SANITSER 7	SETEC	18/12/2013

COMPOSIZIONE IMPASTO

MATERIE PRIME	%	gr secco	% umidità	gr umido
Argilla Hycast Rapida	8	400	7.4	422
Argilla Sembland 90	16	800	11.9	908
Caolino Sembland	22	1100	8.0	1190
Caolino BBZ	8	400	18.5	4580
GS -VF	9.5	475	/	475
BVC - VF	8	400	/	400
F60 - PBVF	18.12	906	/	906
Fluo 7 – VF pegmatite	8	400	/	400
Talco	2.38	119	/	119

OPERAZIONI

MATERIE PRIME PLASTICHE	MATERIE PRIME DURE
Scioglitore	Scioglitore
X	X
Turbodissolutore	Turbodissolutore
Mulino	Mulino
Tempo lav.	Tempo lav.
Corpi macinanti	Corpi macinanti

SETACCIATURA

Luce di maglia (micron)	106	Natura dei Residui
Residuo %	0.06	Carbonatoni e quarzoni

CARATTERISTICHE IN CRUDO

Acqua Barbottina		%	32.5		
Peso specifico Barbottina		g/l	1805		
Viscosità Barbottina		°Q	302		
		Cp		Ritiro essiccamento a bianco	% 2.76
Tixotropia Barbottina		°Q	50	Resistenza meccanica crudo	kgf/cm² 24.29
		Cp		Spessore in 60'	mm 6.8
Deflocculanti	Carbonato Sodio	%	0.07	Spessore in 90'	mm 8.3
	Carbonato Bario	%	0.05	Densità apparente	g/cm³ /
	Silicato Sodio	%	0.08	Plasticità	PP /
				Resistenza meccanica cotto	kgf/cm² 354.9

CARATTERISTICHE IN COTTO

Tipo forno	Intermittente				
Temperatura	1225 °C		Deformazione	mm	46
Colore (secondo Tab. CIE)		L=	Assorbimento	%	0.20
		A=	Ritiro in totale	%	10.95
		B=			
Perdita al fuoco a 1130°	%				

OSSERVAZIONI

Eseguita l'analisi granulometrica.

Cotto a 1170°C

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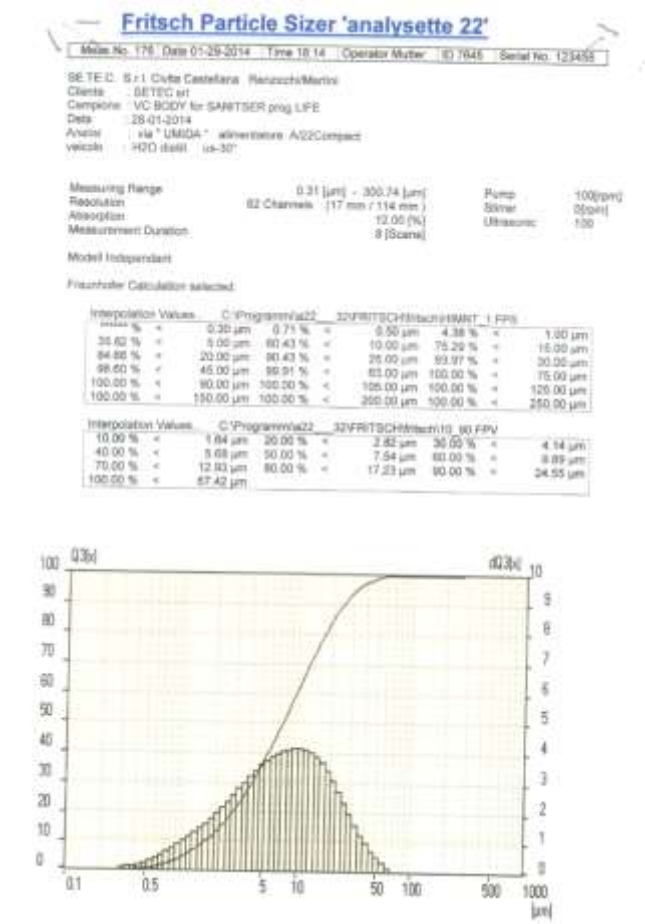
Granulomentric distribution of SANITSER 7

Micron	% Fraction passing for SANITSER 7	% Passing Fraction for VC Standard
5	**35.82**	41.39
10	**60.43**	62.83
25	**90.43**	89.88
30	**93.97**	93.89
45	**98.60**	99.12
63	**99.91**	99.99

Percentage of particles	Average diameter (micron) SANITSER 7	Average diameter (micron) VC Standard
50%	**7.54**	6.61
90%	**24.55**	25.14



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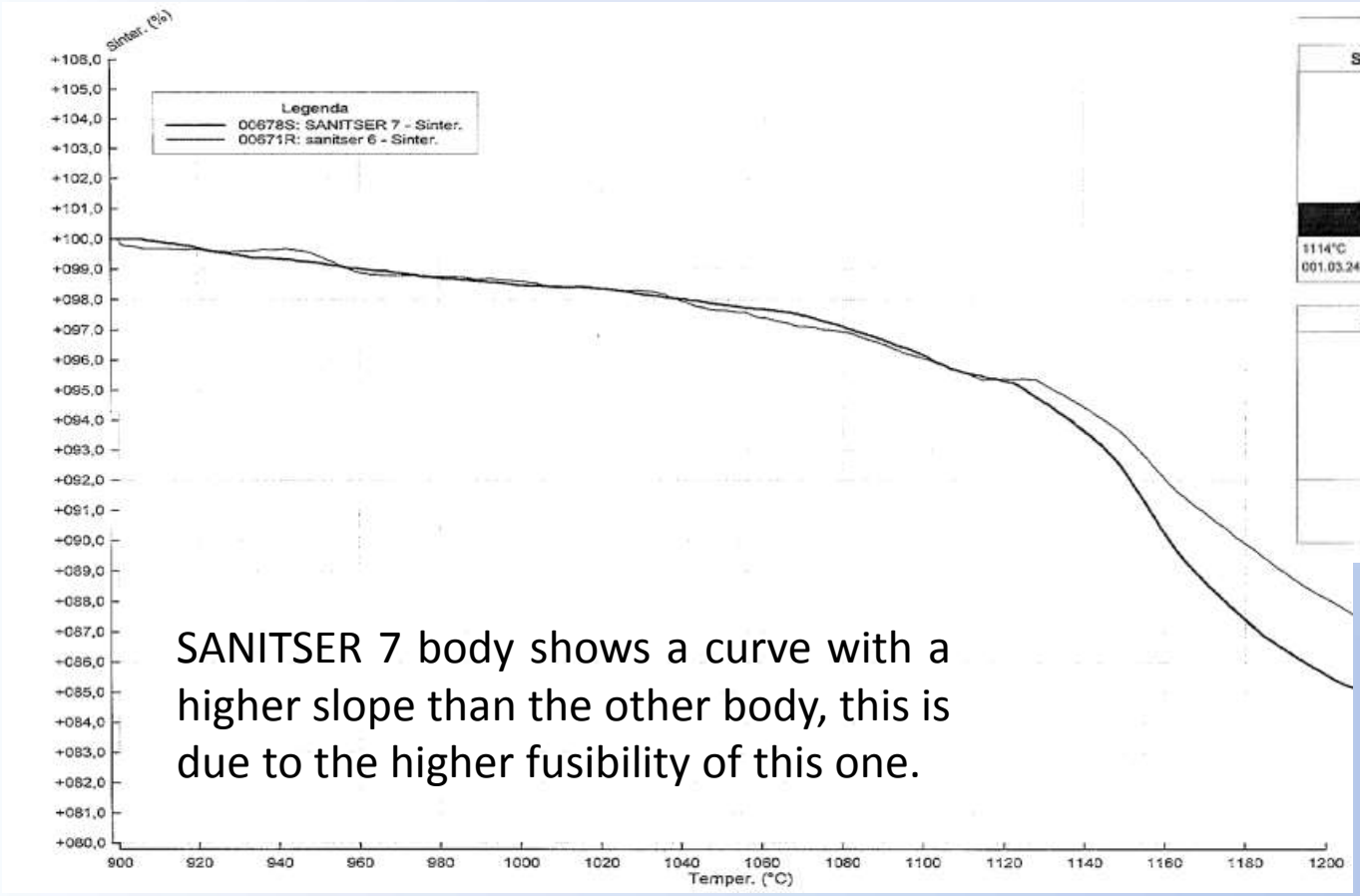
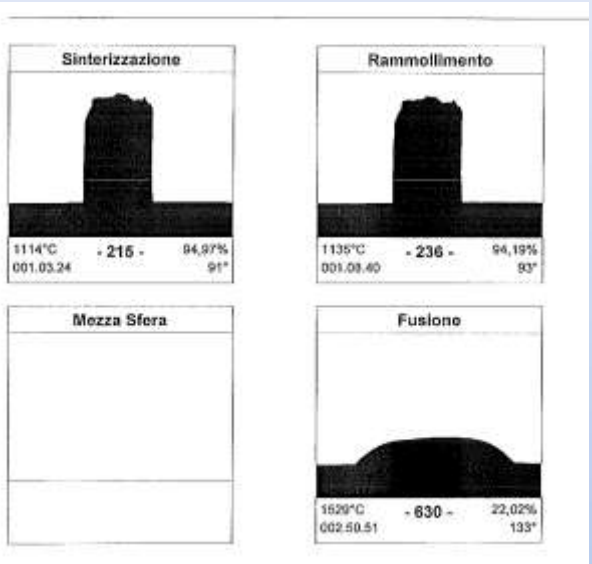
Heating Microscope Test of SANITSER 7





SANITSER 7 body shows a curve with a higher slope than the other body, this is due to the higher fusibility of this one.

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SETEC's Pilot Plant
Semi-Industrial casting test

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Glaze Formulation by G.E.M.I.C.A for SANITSER 7

Raw material	PSI-95 (%)	PSI-97 (%)
Feldspar	19.14	19.04
Calcium carbonate	20.57	20.47
Zinc oxide	4.31	4.29
Zirconium	6.22	8.5
Kaolin	14.35	14.29
Quartz QLZ-FF	23.44	21.43
Glass recovery VBI-FF	11.96	11.91

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SETEC's Pilot Plant
Semi-Industrial glazing test

PSI 95

PSI 97

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Next Steps and New Formulations

Raw material	SANITSER 7 (%)		SANITSER 13 (%)	
Ball clays	24		24	
Kaolin	30		30	
Glass filler "GS-VF“ (GLASS)	9.5		9.5	
Pitcher "BVC-VF“ (SCRAPS)	8	**35,62 %**	8	**43.62%**
Na/K – feldspar "F60-PBVF“ (GRANITE)	18.12		26.12	
Pegmatite Flos 7 – VF	8		/	
Talc	2.38		2.38	

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Conclusions

The introduction of recycled glasses, processing waste granite and grinded V.C. scraps in the body formulation for sanitary ware makes possible, without affecting the quality of final product, to obtain the following benefits:

- **Reduction of production costs**
- **Less exploitation of natural resources**
- **Reduction of C02 emission**
- **Speeding up of firing cycle**