



SANITSER



SANITARYWARE
PRODUCTION

*Use of waste glass for saving
energy and resources*

01/07/2013 – 31/03/2017

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



www.sanitser.eu



SE.TE.C. Group

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

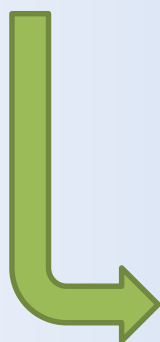


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PARTNERS



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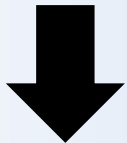
PROJECT OBJECTIVES

Use of waste glass in ceramic Sanitaryware Formulation



**Reduction of industrial
production costs**

**Reduction of
environmental impact**



**Reduction of
virgin raw
materials**

**Reduction of
firing temp. of
80-100°C.**

**Recycling of
urban waste**

**CO₂ emission
reduction**



EXPECTED RESULTS

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%



EXPECTED RESULTS

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%

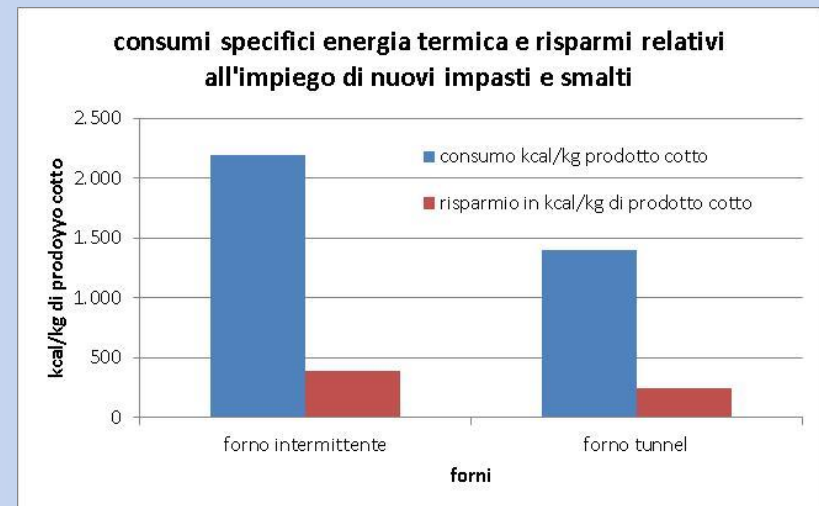


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ENERGY SAVING ECONAMICAL BENEFIT

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/Nm³





ENERGY SAVING ENVIRONMENTAL BENEFIT

Decrease of firing temperature of (about 80-100°C) makes possible a significant reduction of gas emissions from 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



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 CO₂ considering annual average distance of 20.000 km.



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	8	8
Feldspar "F60-PBVF (Recovery granite)	10	21	18.12
Quartz	18	5	/
Talc	/	/	2.38
Pegmatite Flos 7	/	/	8

28 %

41 %

35.62%



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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



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.

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

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

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



Characterization of SANITSER 7

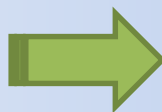
Characteristic	SANITSER 7	STANDARD V.C.
Resistance to bending (kgf/cm ²)	24.29	24
Thickness in 60 minutes (mm)	6.8	6.9
Thickness in 90 minutes (mm)	8.3	8.5
Deformation (mm)	46	43

SCHEDA TECNICA IMPASTO									
CODICE			CLIENTE-NAZIONE			DATA			
VC - SANITSER 7			SETEC			18/12/2013			
COMPOSIZIONE IMPASTO					OPERAZIONI				
MATERIE PRIME	%	gr secco	% umidità	gr umido	MATERIE PRIME PLASTICHE		MATERIE PRIME DURE		
Argilla Hycast Rapide	8	400	7.4	432	Scioglitore		Scioglitore		
Argilla Sanblend 90	16	800	11.9	908	X		X		
Caolino Remblend	22	1100	8.0	1190	Turbodissolutore		Turbodissolutore		
Caolino BBZ	8	400	10.5	4500					
GS - VF	9.5	475	/	475	Mulino		Mulino		
BVC - VF	8	400	/	400					
F60 - PBVF	18.12	906	/	906	Tempo lav.		Tempo lav.		
Flos 7 - VF pegmatite	8	400	/	400					
Talco	2.38	119	/	119	Corpi macinanti		Corpi macinanti		
SETACCIATURA									
			Luce di maglia (micron) 106		Natura dei Residui				
			Residuo % 0.06		Carboniosi e quarzosi				
CARATTERISTICHE IN CRUDO									
Acqua Barbotina		%	32.5						
Peso specifico Barbotina		g/lt	1805						
Viscosità Barbotina		°G	302						
		Cp			Ritiro essiccamento a bianco	a	%	2.76	
Tissotropia Barbotina		°G	30		Resistenza meccanica crudo		kgf/cm²	24.29	
		Cp			Spessore in 60'		mm	6.8	
		%	0.07		Spessore in 90'		mm	8.3	
Deflocculanti	Carbonato Sodio	%	0.05		Densità apparente		g/cm³	/	
	Carbonato Bario	%	0.08		Plasticità		PF	/	
	Silicato Sodio	%	0.08		Resistenza meccanica cotto		kgf/cm²	554.9	
CARATTERISTICHE IN COTTO									
Tipo forno		Intermittente							
Temperatura		1225 °C		Deformazione		mm		46	
Colore (secondo Tab. CEE)				L=		Assorbimento		%	
				A=		Ritiro in totale		%	
				B=					
Perdita al fuoco a 1150°		%							
OSSERVAZIONI									
Eseguita l'analisi granulometrica.									
Cotto a 1170°C									



SETEC's Pilot Plant

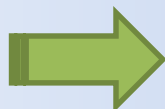
Semi-Industrial tests





SETEC's Pilot Plant

Semi-Industrial tests





New 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	8
Na/K – feldspar "F60-PBVF" (GRANITE)	18.12	26.12
Pegmatite Flos 7 – VF	8	/
Talc	2.38	2.38

35,62 %

43.62%



Characterization for SANITSER 13

Characteristics	SANITSER 7	SANITSER 13	VC Standard
Resistance to bending (kgf/cm ²)	24.29	25.29	24
Thickness in 60 minutes (mm)	6.8	6.5	6.9
Thickness in 90 minutes (mm)	8.3	8.2	8.5
Deformation (mm)	46	43	43

Characteristic	Standard VC	Our SANITSER 13
Specific weight	1.8 ÷ 1.85 Kg/dm ³	1.810
Gallenkamp viscosity	290 ÷ 320 °	300
Gallenkamp thixotropy (After 1 minute)	25 ÷ 40	30
pH	8 ÷ 9	8.4
Temperature	18 ÷ 25	23

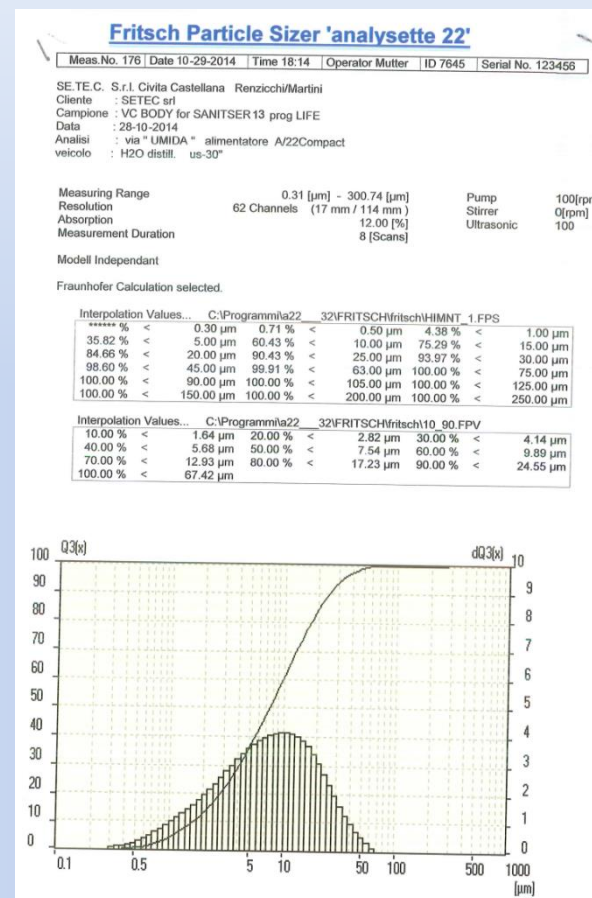


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Granulometric Distribution

Micron	Passing % for SANITSER 13	Passing % 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

% of particles	Average diameter (micron) SANITSER 13	Average diameter (micron) VC Standard
50%	7.54	6.61
90%	24.55	25.14





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SANITSER 13 and PSI-103

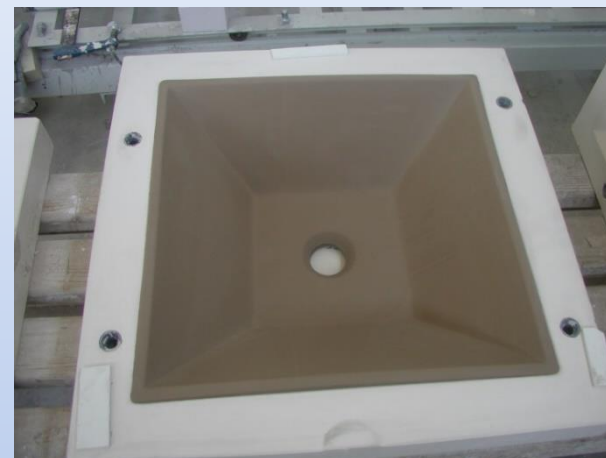
Dilatometric Coefficient

Temperature range (°C)	Dilatometric coefficient α for Vitreous china standard	Dilatometric coefficient α for SANITSER 7	Dilatometric coefficient α for SANITSER 13	Dilatometric coefficient α for glaze PSI-103
50-300	64.52	69.50	74.11	70.73
50-400	65.47	69.16	73.56	70.61
50-500	66.71	69.52	73.70	70.45
50-650	71.19	71.37	75.79	71.54
300-500	69.45	69.86	73.20	70.10
500-650	84.62	76.94	82.06	74.80



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Semi-industrial casting tests





SANITSER 13

Semi-industrial casting tests





SANITSER 13

Semi-industrial firing tests

Temperature range (°C)	Time (min)
0-60	10
60-120	30
120-270	60
270-330	20
330-500	60
500-650	90
650-850	60
850-1050	150
1050-1165	60
1165-1165	40
1165-1065	10
1065-680	60
680-500	180
500-150	90
150-50	60





SANITSER 13

Analysis on the fired articles

Shrinkage between the fired pieces and the dry piece

dimensions	Model pedestal BETA			Model pedestal BOHEMIEN			Model wall-hung BOHEMIEN		
	Dry (cm)	Fired (cm)	Shrinkage (%)	Dry (cm)	Fired (cm)	Shrinkage (%)	Dry (cm)	Fired (cm)	Shrinkage (%)
H	44.3	38.9	12.2	48	42.0	12.5	34.1	29.9	12.3
L	57.5	50.2	12.2	59.6	53.7	12.5	58.8	51.6	12.3

The shrinkages registered on the fired pieces are in compliance with the standard values found for vitreous china body, which is in the range 12-13%.

Comparison of the resistance to bending found on fired piece (SANITSER) and standard VC.

SANITSER 13 glazed (with PSI-103) (N)	Standard Vitreous China glazed (N)
4950	4500

The value obtained is in compliance with the norm UNI 4543 for the ceramic body (this norm required a value of 3950 N) and the SANITSER 13 body shows more resistance to bending compared with a standard VC body (+11%).



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 CO₂ emission**
- **Speeding up of firing cycle**



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GRAZIE PER L'ATTENZIONE