



CENOBEAD™

(CZS : Zirconium Silicate Bead)

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Types of grinding media

Type	Glass	Glass Ceramics and Ceramics	New Ceramics
Media Life	Short	Moderate	Long
Media Breakage	Very High	Moderate	Low
Contamination	Poor	Moderate	Excellent
Cost/ Overall Cost	Low/High	Medium/Medium	High/Medium
Material	Soda Lime Glass	Zirconium Silicate Alumina, Titania	3Y-TZP Ce-TZP MgO-PSZ CaO-PSZ

Zirconium Silicate

* Disadvantages

- 1) relatively lower density, hardness, and strength than zirconia ceramics
- 2) lower wear resistance than zirconia, internal pores and weak silica matrix
- 3) lower grinding/dispersion efficiency than Zirconia

* Advantages

- 1) Higher grinding/dispersion efficiency than Glass Bead
- 2) Adequate to sand mills and vertical type mills in which heavy zirconia media cannot be used
- 3) Moderate Cost

Types of Zirconium Silicate Beads

Company	Process	Microstructure
S	Electrofused	Amorphous silica matrix/ZrO ₂ crystalline
R	Sintered	Amorphous silica grainboundary/ZrSiO ₄ crystalline
F	Sintered	Amorphous silica grainboundary/ZrSiO ₄ crystalline
Young's coporation	Sintered	ZrSiO ₄ microcrystalline

Chemical composition

		S	F	R	CZS
Chemical Composition (w%)	ZrO ₂	68	64	58	62
	SiO ₂	31	33	37	33
	Others	1	3	5	5

***CZS** : zirconium silicate beads

Physical property

			S	F	R	CZS
Density (g/cm ³)	Spec.		3.90	4.55	4.0	>4.0
	T E S t	1.0mm	4.10	4.11	4.09	4.13
		1.5mm	4.10	4.09	4.25	
		2.0mm	4.10	4.08	4.25	
Bulk Density			2.35	2.55	2.55	2.55
Hardness (Mohs / Vickers)	Spec.		7.0	820-920	800	>1,000
	T E S t	1.0mm	N/A	952.1±24.9	952.4 ±20.3	1,072.4±12.9
		1.5mm		948.4±15.0	952.4 ±2.82	
		2.0mm		953.6±13.9	920.7 ±26.9	

XRF : R/ F /S /CZS

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Quantification of sample 1472-P4 03. Mar. 2003 QL

R.M.S.:	0.000
Sum before normalization:	139.5 %
Normalised to:	100.0 %
Sample type:	Pressed powder
Correction applied for medium:	Yes
Correction applied for film:	1
Used Compound list:	OXIDES
Results database:	iq+liquid
Results database in:	c:\program files\philips\superq\userdata

Compound Name	Conc. (%)	Absolute Error (%)
1 Al2O3	4.084	0.09
2 SiO2	33.974	0.2
3 P2O5	0.629	0.01
4 K	<<	
5 CaO	0.820	0.02
6 TiO2	0.189	0.007
7 Fe	<<	
8 Y2O3	0.149	0.001
9 ZrO2	58.532	0.2
10 HfO2	1.613	0.01
11 Ti	<<	

R

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Quantification of sample 1472-P3 03. Mar. 2003 FC

R.M.S.:	0.000
Sum before normalization:	146.3 %
Normalised to:	100.0 %
Sample type:	Pressed powder
Correction applied for medium:	Yes
Correction applied for film:	1
Used Compound list:	OXIDES
Results database:	iq+liquid
Results database in:	c:\program files\philips\superq\userdata

Compound Name	Conc. (%)	Absolute Error (%)
1 MgO	0.586	0.02
2 Al2O3	5.834	0.1
3 SiO2	37.058	0.2
4 P2O5	0.580	0.01
5 K	<<	
6 CaO	1.003	0.02
7 TiO2	0.237	0.007
8 Fe2O3	0.158	0.004
9 As	<<	
10 Y2O3	0.112	0.001
11 ZrO2	53.110	0.1
12 Cs	<<	
13 HfO2	1.322	0.01
14 Ti	<<	

F

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Quantification of sample 1472-P1 03. Mar. 2003 SE

R.M.S.:	0.000
Sum before normalization:	127.8 %
Normalised to:	100.0 %
Sample type:	Pressed powder
Correction applied for medium:	Yes
Correction applied for film:	1
Used Compound list:	OXIDES
Results database:	iq+liquid
Results database in:	c:\program files\philips\superq\userdata

Compound Name	Conc. (%)	Absolute Error (%)
1 Al2O3	3.693	0.09
2 SiO2	37.174	0.2
3 Ca	<<	
4 Ti	<<	
5 Fe2O3	0.157	0.003
6 As	<<	
7 Y2O3	0.137	0.001
8 ZrO2	57.506	0.2
9 Cs	<<	
10 HfO2	1.333	0.01
11 Th	<<	

S

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Quantification of sample 1472-P2 03. Mar. 2003 CZS

R.M.S.:	0.000
Sum before normalization:	144.4 %
Normalised to:	100.0 %
Sample type:	Pressed powder
Correction applied for medium:	Yes
Correction applied for film:	1
Used Compound list:	OXIDES
Results database:	iq+liquid
Results database in:	c:\program files\philips\superq\userdata

Compound Name	Conc. (%)	Absolute Error (%)
1 Al2O3	5.415	0.1
2 SiO2	34.993	0.2
3 P	<<	
4 K	<<	
5 CaO	0.559	0.01
6 TiO2	0.180	0.007
7 Fe	<<	
8 Y2O3	0.205	0.001
9 ZrO2	57.222	0.1
10 Cs	<<	
11 HfO2	1.426	0.01
12 Ti	<<	

CZS

Crushing Strength

(kgf)

Size (mm)	Zirconia TZP Bead		Zircon(Zirconium Silicate) Bead			
	CZY Min(Ave)	CZC Min(Ave)	R (Ave)	F (Ave)	S (Ave)	CZS (Ave)
1.00	40(70)	30(45)	23.60 ±7.84	20.37±2.58	26.02 ±5.51	25.26±10.72
1.50	100(120)	70(100)	33.52 ±2.82	52.74±7.79	–	73.18±13.48
2.00	200(250)	160(200)	54.63 ±4.98	117.36±36.79	72.22 ±15.45	106.15±21.79

*** CZS has the highest crushing strength**