

**CENOBEAD™**  
**(CZY & CZC : Stabilized Zirconia Bead)**

**YOUNG'S CORPORATION**  
**[www.youngscorp.com](http://www.youngscorp.com)**

## What is Grinding Media?

### Grinding Media

Today's industries aim to deliver high quality products to customers by utilizing raw materials that possess a high degree of purity. Therefore, the manufacture, dispersion, and grinding of raw materials has never been more important. In this manufacturing process, a media is used for grinding and/or dispersion, and this media is called the bead or ball.

Beads can be classified or grouped as ceramic, metal, and polymer. In general, ceramic beads are broadly used for inner wear resistance material due to their high fracture resistance and hardness. The most widely used ceramic beads in the industry are Zirconia ( $ZrO_2$ ), Alumina ( $Al_2O_3$ ), Zircon ( $ZrSiO_4$ ), Glass, Titania ( $TiO_2$ ), and  $Si_3N_4$  beads.

### Media Criteria for Horizontal Mills and Vertical Mills

In general, a grinding or dispersion mill can be categorized as a horizontal or vertical mill. To these mills, the media's material characteristics are very important; for example, the spherical shape, surface structure, hardness, density, toughness, even size distribution of the bead relates directly to the product quality, bead-life and mill-life.

GLASS	CENOBeads (CZS)	ZIRCON	CENOBeads (CZC)	Competitive Ce-TZP	CEONBeads (CZY)	Competitive 3Y-TZP

[Table 1] Type of Grinding Media

## Ceramic Media Criteria with Improved Efficiency

	Steel	Glass	Alumina	Zircon	Mg-PSZ	Ce-TZP	Y-TZP
Specific Gravity	7.8	2.5	3.8	3.8	5.6	6.2	6.0
Bulk Density	–	1.6	2.3	2.3	–	3.8	3.6
Hardness	400–800	600	1500	900	1000	1200	1300
Crush Strength	600–800	500–1200	–	200	440–720	500–800	800–1300
Fracture Toughness	15	0.2–0.8	–	5	4.6	8.3	11.6
Contamination	Poor	Poor	Poor	Poor	Moderate	Excellent	Excellent
Sphericity	Good	Good	Moderate	Poor	Moderate	Moderate	Excellent
Size Distribution	Good	Good	Moderate	Poor	Moderate	Moderate	Excellent
Bead Size	0.2–20.0	0.1–4.5	0.5–40.0	0.2–2.5	0.4–2.0	0.4–3.3	0.1–20.0

[Table 2] Typical Mechanical Properties for some Media Materials

## Chemical Composition & Physical Properties of CZY

Yttria Stabilized Zirconia Bead (CZY)		
Element	Unit	Specification
ZrO <sub>2</sub> + HfO <sub>2</sub>	Wt/%	94.9 ± 0.2
Y <sub>2</sub> O <sub>3</sub>	Wt/%	5.1 ± 0.2
Al <sub>2</sub> O <sub>3</sub>	Wt/%	0.2
Fe <sub>2</sub> O <sub>3</sub>	PPM	<50
SiO <sub>2</sub>	PPM	<100
TiO <sub>2</sub>	PPM	<100
Na <sub>2</sub> O	PPM	<100
MgO	PPM	<100
CaO	PPM	<100

Yttria Stabilized Zirconia Bead (CZY)	
Specific Density	>6.00
Color	Ivory
Microhardness(Hv)	>1300
Bulk Density	>3.6
Thermal Conductivity	0.008
Bending Strength	60
Average Grain Size	0.2–0.4
Bead Size(mm)	0.3/0.5/0.8/1.0/1.2/1.5/2.0
Packing(net wt)	20kgs

[Table 3] Chemical Composition & Physical Properties of CZY

## Chemical Composition & Physical Properties of CZC

Ceria Stabilized Zirconia Bead(CZC)		
Element	Unit	Specification
ZrO <sub>2</sub> + HfO <sub>2</sub>	Wt/%	79.0 ± 0.2
CeO <sub>2</sub>	Wt/%	21.0 ± 0.2
Al <sub>2</sub> O <sub>3</sub>	Wt/%	0.6
Fe <sub>2</sub> O <sub>3</sub>	PPM	<100
SiO <sub>2</sub>	PPM	<100
TiO <sub>2</sub>	PPM	<100
Na <sub>2</sub> O	PPM	<100
MgO	PPM	<100
CaO	PPM	<100

Ceria Stabilized Zirconia Bead(CZC)	
Specific Density	>6.20
Color	Brown
Microhardness(Hv)	>1200
Bulk Density	>3.8
Thermal Conductivity	2.0
Bending Strength	60
Average Grain Size	0.2–0.5
Bead Size(mm)	0.3/ 0.5/1.0/1.2 /1.5 / 2.0 / 2.7
Packing(net wt)	20kgs

[Table 4] Chemical Composition & Physical Properties of CZC

## Chemical Composition & Physical Properties of Zirconium Silicate

Zirconium Silicate (CZS)		
Element	Unit	Specification
ZrO <sub>2</sub>	Wt/%	68.0
SiO <sub>2</sub>	Wt/%	31.0
Al <sub>2</sub> O <sub>3</sub>	Wt/%	1.0
Fe <sub>2</sub> O <sub>3</sub>	Wt/%	
SiO <sub>2</sub>	Wt/%	
TiO <sub>2</sub>	Wt/%	
Na <sub>2</sub> O	Wt/%	
MgO	Wt/%	
CaO	Wt/%	

Zirconium Silicate (CZS)	
Specific Density	4.0
Color	White
Microhardness(Hv)	1000
Bulk Density	2.4
Thermal Conductivity	–
Bending Strength	–
Average Grain Size	–
Bead Size(mm)	0.2–2.5
Packing(net wt)	–

[Table 5] Chemical Composition & Physical Properties of Zircon

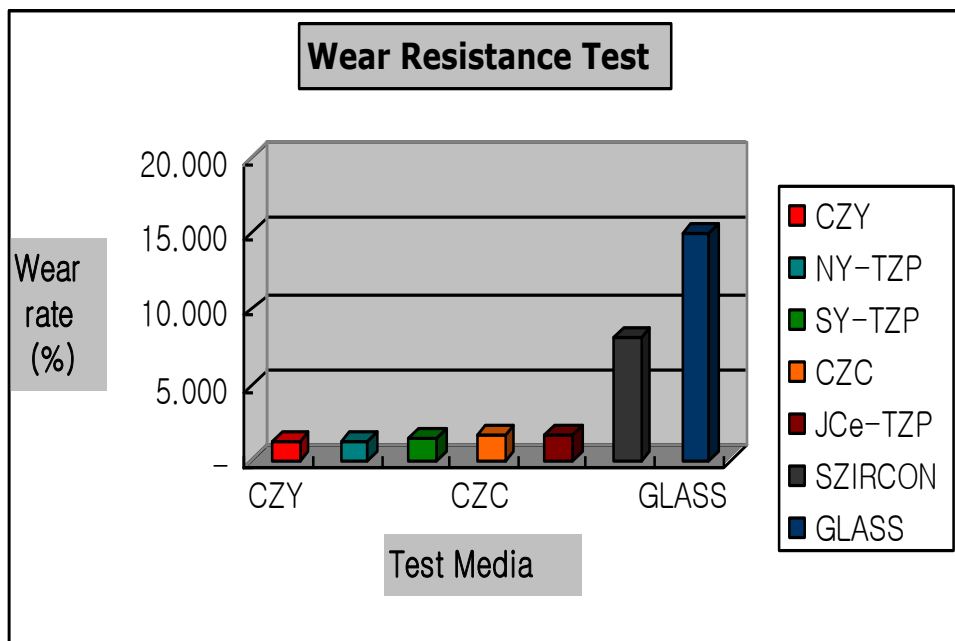
## Chemical Composition & Physical Properties of Glass

Glass Bead		
Element	Unit	Specification
SiO <sub>2</sub>	Wt/%	57.0
Na <sub>2</sub> O	Wt/%	0.2
K <sub>2</sub> O	Wt/%	0.6
CaO	Wt/%	18.0
MgO	Wt/%	3.0
Al <sub>2</sub> O <sub>3</sub>	Wt/%	14.0
B <sub>2</sub> O <sub>3</sub>	Wt/%	7.0
Fe <sub>2</sub> O <sub>3</sub>	Wt/%	<0.3
PbO	Wt/%	<0.01

Glass Bead	
Specific Density	2.5
Color	Transparent
Microhardness(Hv)	600
Bulk Density	1.6
Thermal Conductivity	–
Bending Strength	–
Average Grain Size	–
Bead Size(mm)	0.1–4.5
Packing(net wt)	–

[Table 6] Chemical Composition & Physical Properties of Glass

## Wear resistance data(%)

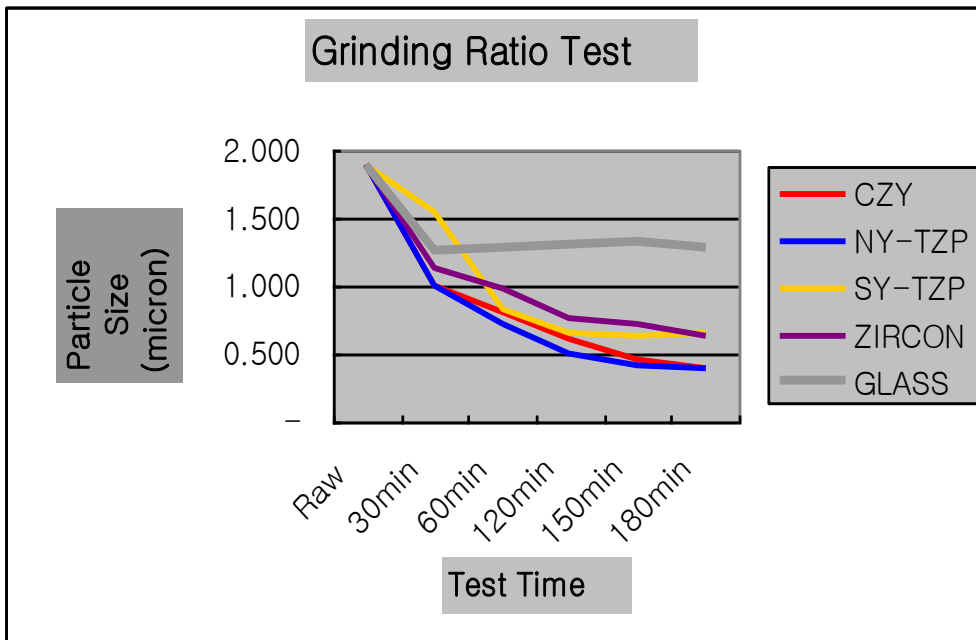


Mill Maker	KMDC(Korea)
Model	(01-HDDM ) (high speed vertical lab bead mill)
Mill container	SUS 304
Mill capacity	1500ml
Agitator speed	MAX 3,000rp(Operating 2,500rpm)
Media quantity	800ml
Material	<b>SIC powder 205g</b>
Water	130ml / Dispersion Agent 30ml
Bead size	CZY (0.9-1.1 mm ) N / Y-TZP(1.0mm) S / Y-TZP(0.9-1.1mm) CZC (0.9-1.1 mm) J / Ce-TZP(0.8-1.2m) Glass (0.8-1.2mm) S / Zirconium Silicate(0.8-1.2mm)

Type	CZY	NY-TZP	SY-TZP	CZC	Jyoti-TZP	SZIRCON	GLASS
180min	1,390	1,330	1,470	1,750	1,800	8,167	15,110



## Grinding ratio data( $\mu\text{m}$ ) – Yttria Stabilized Zirconia Bead



Mill Maker	KMDC(Korea)
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Material	<b>SIC powder 205g</b>
Water	130ml / Dispersion Agent 30ml
Bead size	CZY (0.9–1.1 mm ) N / Y-TZP(1.0mm) S / Y-TZP(0.9–1.1mm) CZC (0.9–1.1 mm) J / Ce-TZP(0.8–1.2m) Glass (0.8–1.2mm) S / Zirconium Silicate(0.8–1.2mm)

구분	CZY	NY-TZP	SY-TZP	CZC	JCe-TZP	ZIRCON	GLASS
Raw	1.900	1.900	1.900	1.900	1.900	1.900	1.900
30min	1.003	1.009	1.544	0.994	1.270	1.127	1.269
60min	0.798	0.723	0.819	0.741	1.051	0.969	1.285
120min	0.601	0.492	0.661	0.472	0.684	0.770	1.301
150min	0.459	0.411	0.631	0.408	0.577	0.723	1.317
180min	0.410	0.390	0.642	0.488	0.543	0.624	1.274