AVTO G D.O.O.

Industrial/technical ceramics and spare parts

FACTS

- Factory production was established in 1972.
- 350 employees/ 28 engineers in R&D department
- We are exporting our products to 78 countries.
- Annual turnover around 20 million EUR.

FIELD OF PRODUCTION

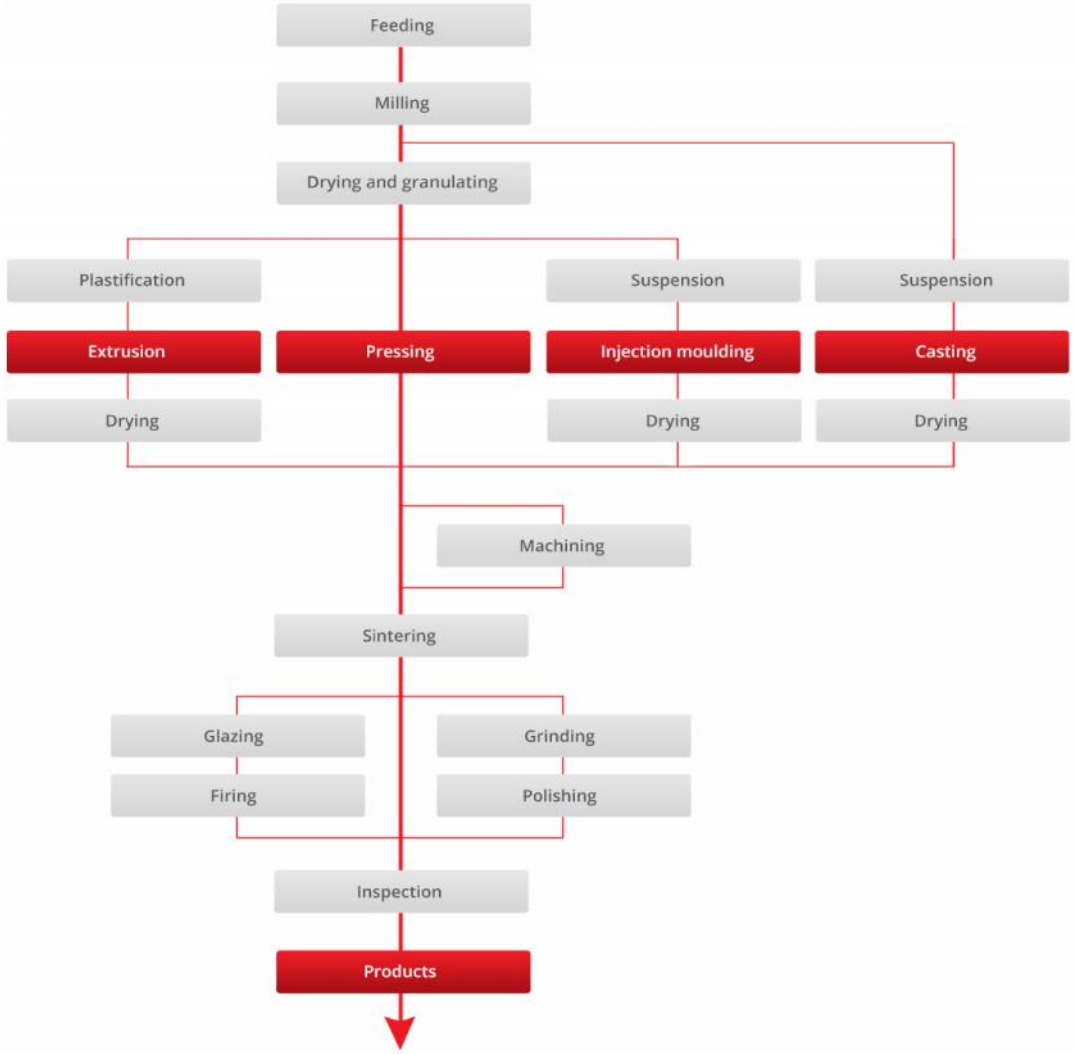
- Industrial/technical ceramics
- Components for spark plugs producers
- Industrial igniters/burners for GAS

CERAMICS PRODUCTION METHODS

- There are 4 different production methods for ceramics:

1. Mechanical or cold/hot ISOSTATIC pressing
2. Extruding
3. Dye casting
4. Injection moulding

CERAMICS PRODUCTION METHODS



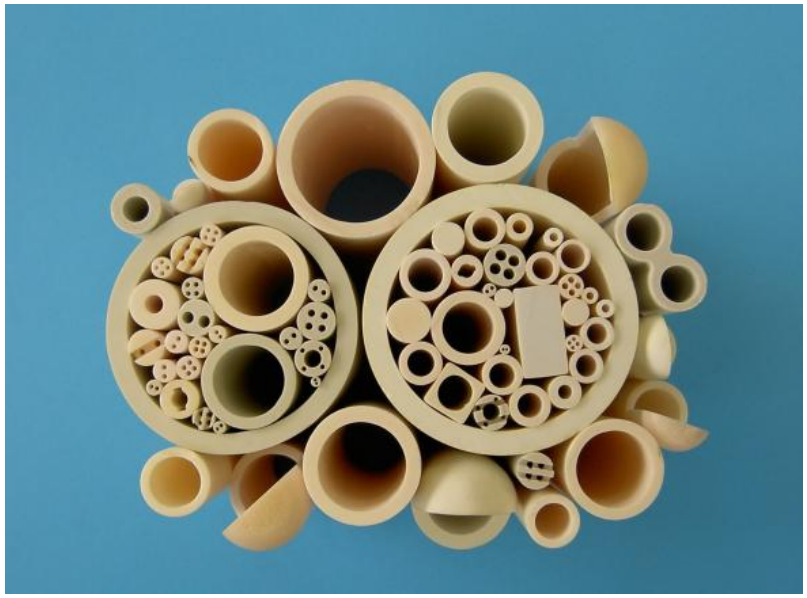
MATERIALS

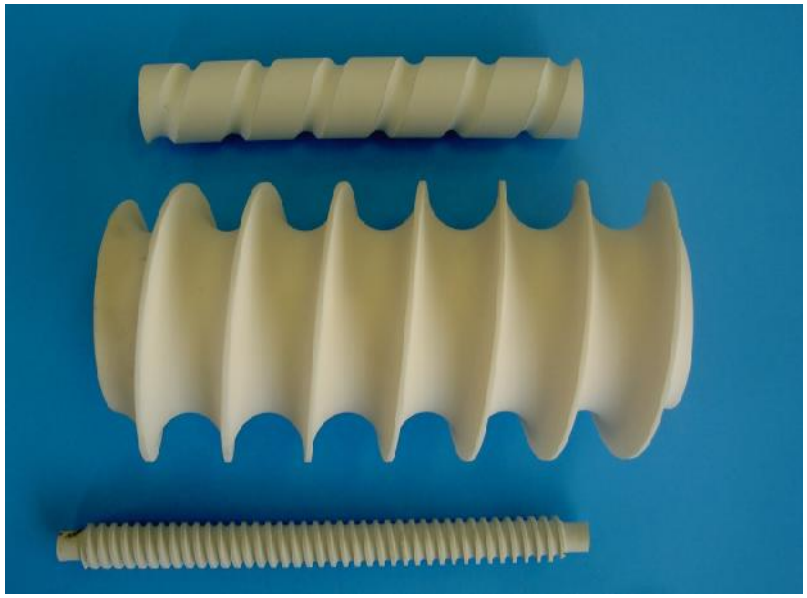
TYPICAL PROPERTIES OF CERAMIC MATERIALS; ACCORDING TO EN-DIN 60672-3

CHARACTERISTICS	UNITS	C110/C120	C220/C221	C410	C530	C610	C786	C795	C799	ZIRCONIA	
		HARD PORCELAIN	STEATITE	CORDIERIT	CONDERITE - AR-SILIKAT	MULITE	HIGH ALUMINIUM CERAMICS			STABILISED WITH Y-TZP	STABILISED WITH Mg-PSZ
Nominal composition	%	Al_2O_3 SiO_2	$MgOSiO_2$	$2Mg02Al_2O_35SiO_2$	78	62	92	95	99,7	$ZrO_2 + Y_2O_3$	$ZrO_2 + MgO$
Specific density	g/cm^3	2,3	2,7	2,1	2,5	2,7	3,63	3,68	3,8 - 3,9	6	5,5
Water absorption	%	0	0	0,5	8 - 12	0	0	0	0	0	0
Hardness	Mohs				6	8	9	9	9	8 - 9	8
Modulus of elasticity, min.	GPa	60	110	-	-	100	240	280	300	200	200
Compresive strength	MPa	400	850	300	-	550	2000	2300	3000	2800	2500
Flexural strength	MPa	50	140	60	30	120	250	280	300	1000	350
Thermal expansion (20 - 1000C)	$10^{-6}K^{-1}$	4-6	8	2-4	4-6	6	6-8	6-8	7-8	10-11	10
Thermal conductivity (20 - 1000C)	W/MK	1,4	2-3	1,2-2	1,5-2	3-5	14-23	17-25	20-30	2,2	3
Resistance to thermal schock	Deg.	150-160	100-150	250	350	150	140	140	150	210-230	180-190
Max. working temperature	Deg.	-	1200	1200	1450	1500	1500	1550	1650	1300-1400	1100-1200
Dielectric strenght	KV/mm	20	20	10	-	17	15	15	17	9	-
Dielectric constant (20deg. 1Mhz)	-	5,5	6	5	5	6	8	8,5	9,5	15-17	-
Dissipation factor at 20 deg., 48-60Hz	10^{-3}	25	1,5	25	-	-	0,5	0,5	0,2	0,001-0,002	-

PRODUCTS

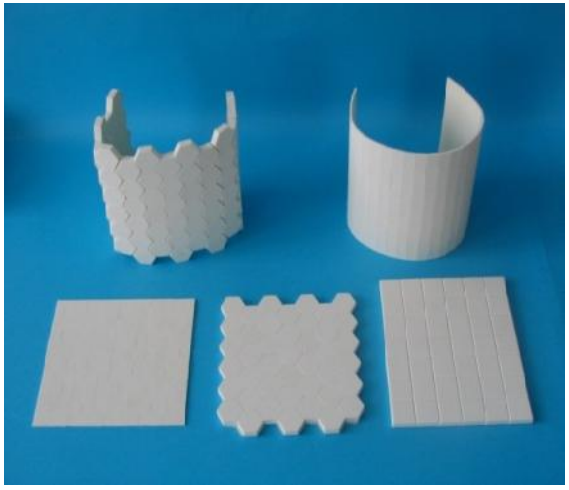
- Ceramic tubes and isolators for thermocouples; Material: C 530, C 610, C 795, C 799





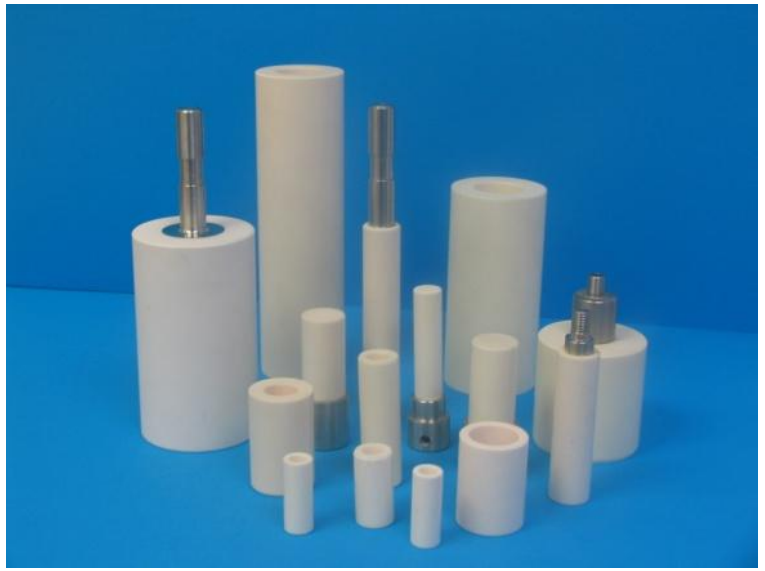
PRODUCTS

- Ceramic for mill lining, elements for milling and mozaics



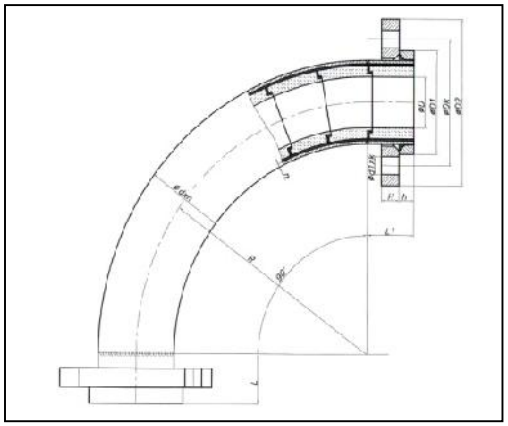
PRODUCTS

- Ceramic seals and pistons for water pumps



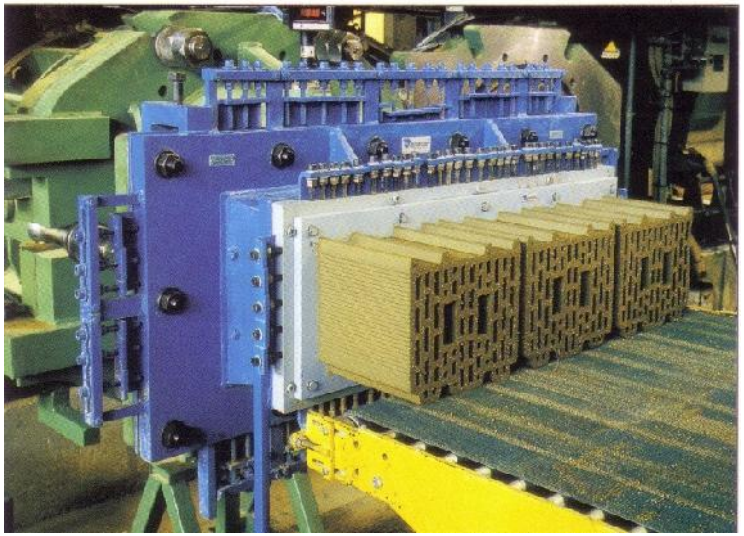
PRODUCTS

- Tubes and elbows with ceramic lining for hydraulic and pneumatic transport of very abrasive materials



PRODUCTS

- Ceramic tools for brick extruding

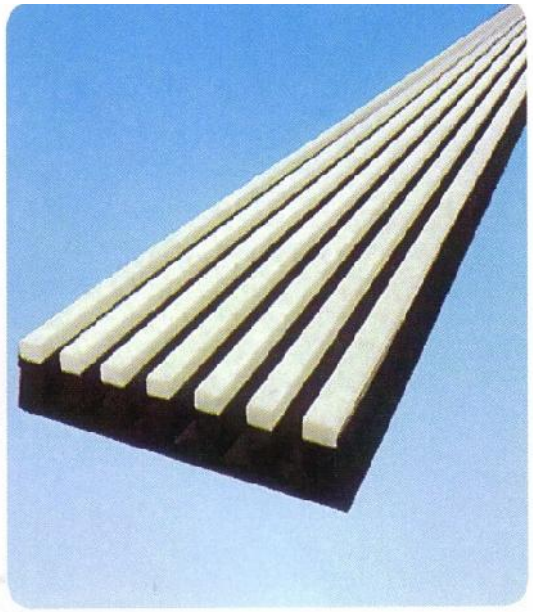


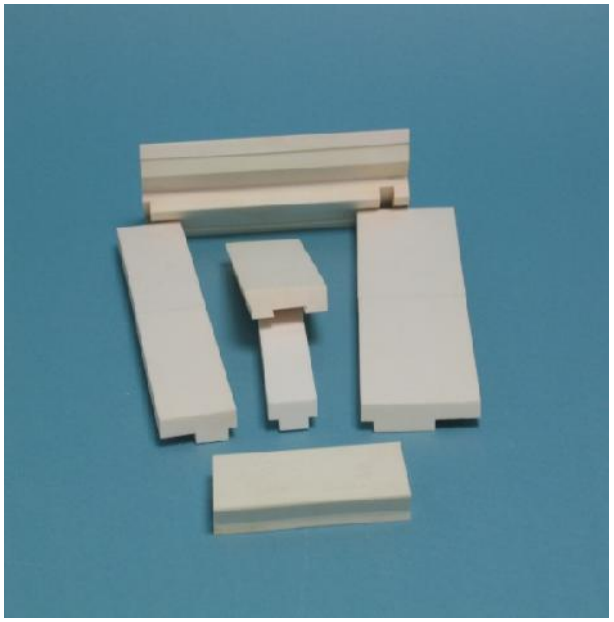
PRODUCTS

- Ceramic for wire and textile production – wire and thread guide

PRODUCTS

- Ceramic for paper industry





PRODUCTS

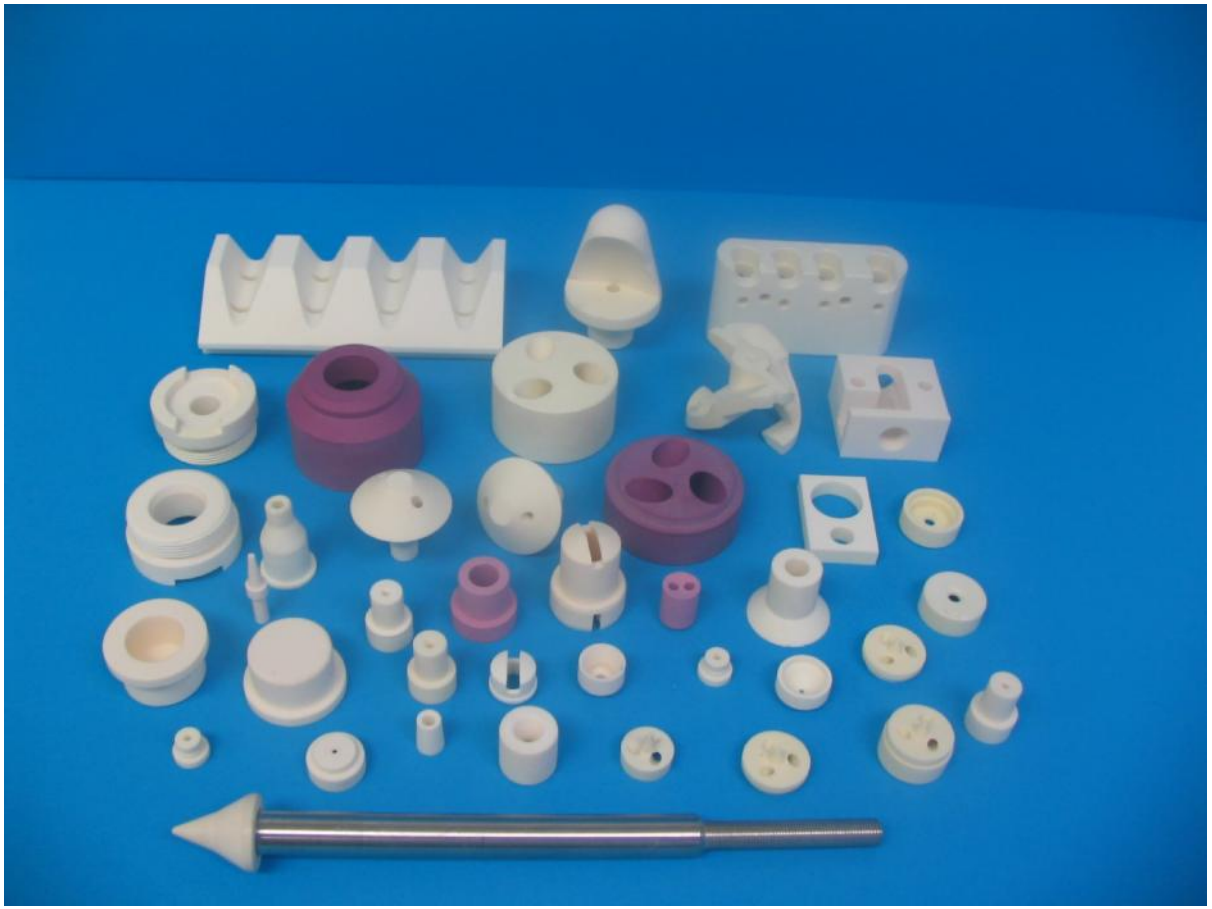
- Ignition electrodes for gas and oil equipment

PRODUCTS

- Welding nozzles for TIG and MIG welding

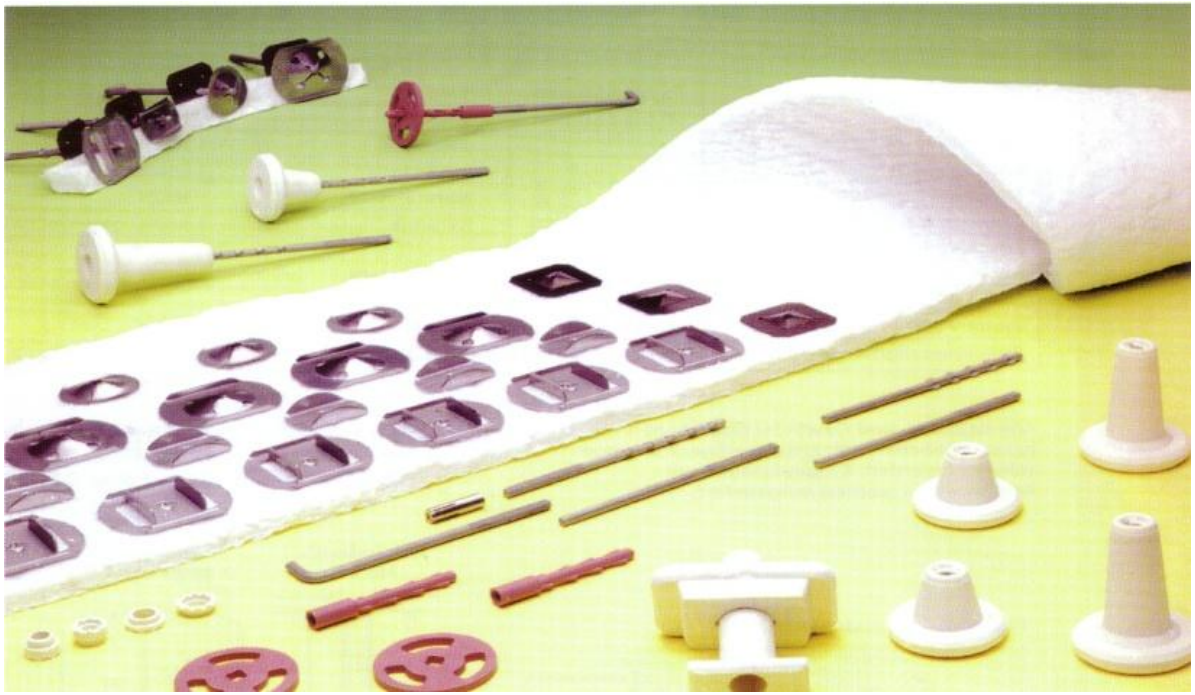
PRODUCTS

- Ceramics for chemical industry



PRODUCTS

- Elements for fixing the thermo-isolators in the furnaces



PRODUCTS

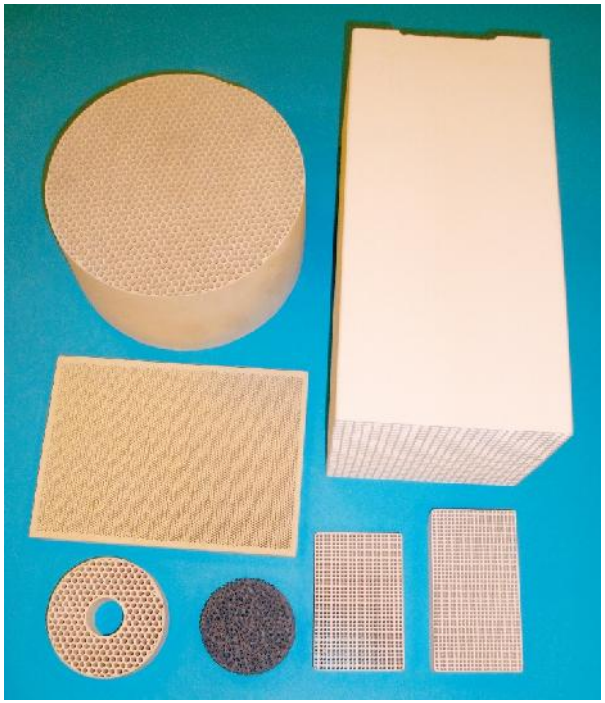
- Components for spark plugs

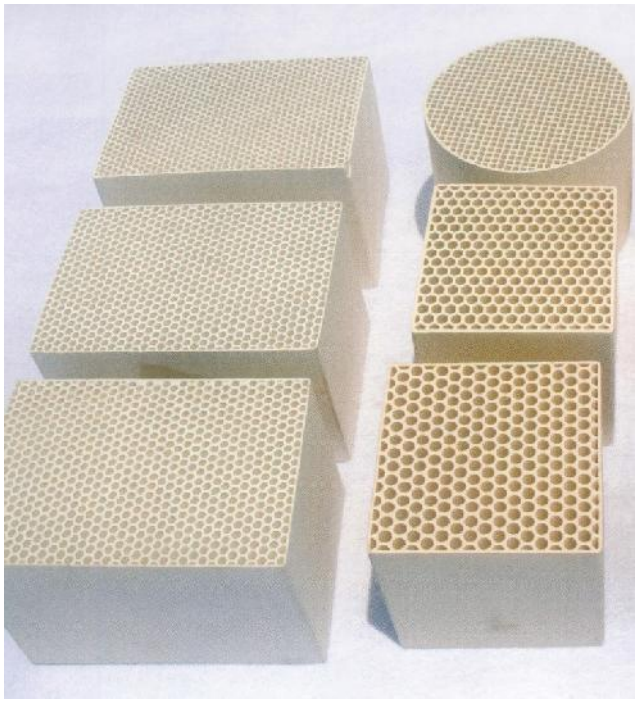
PRODUCTS

- Tools from hard metal

PRODUCTS

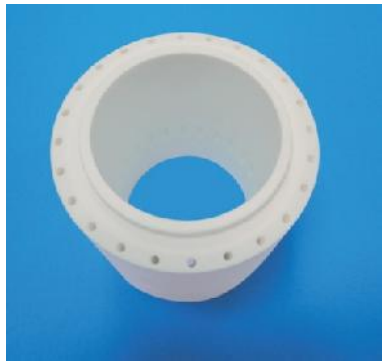
- Ceramic honeycomb filters/heat exchangers





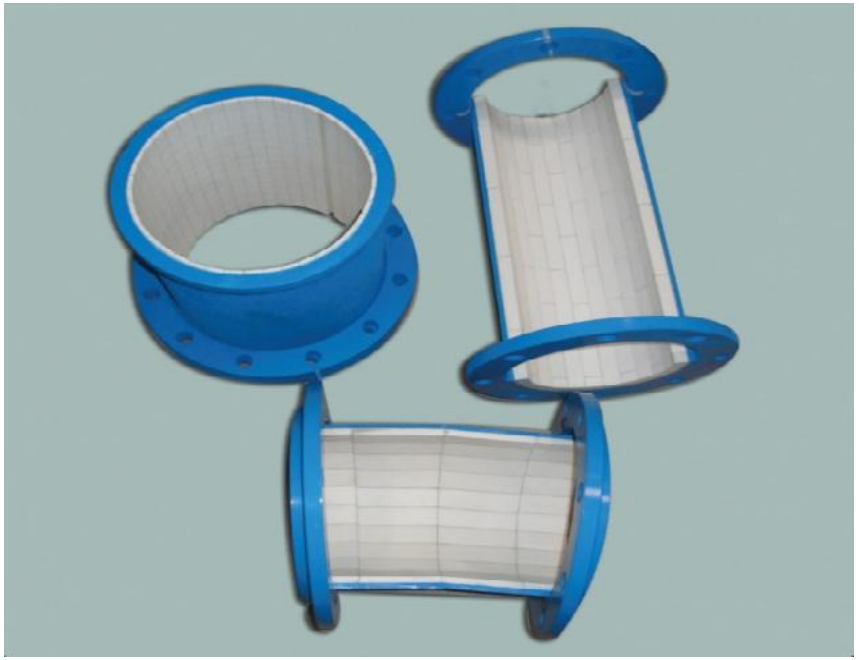
MAIN PRODUCTS

- Wear protection material



- Wear protection material

Tubes and elbows with inner diameter of ceramic up to DN 200 mm are made from ceramic cylindrical segments, which have male and female parts (see photo up left). At assembly this assures high quality of joint and long life time.

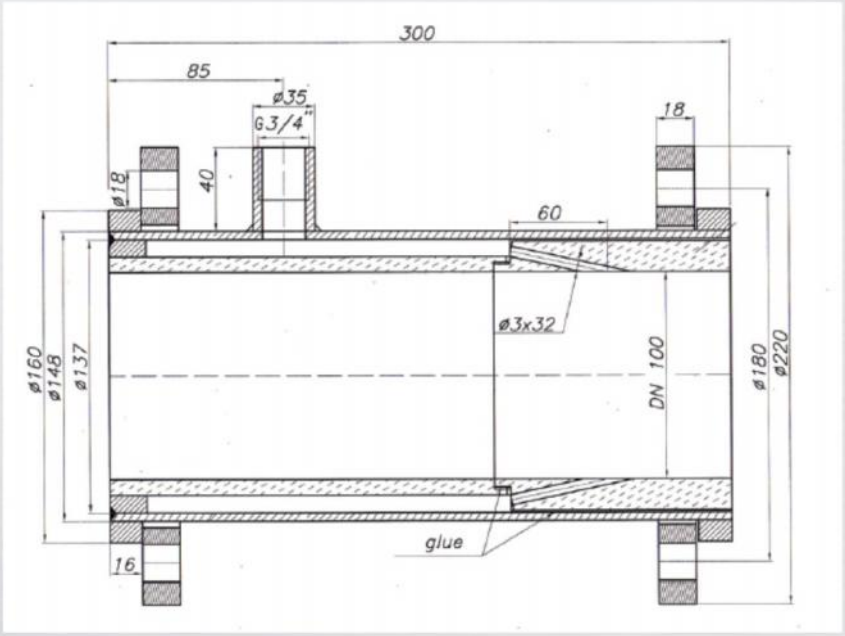


Tubes and elbows which have inner diameter bigger than DN 200 mm are lined with panels (mosaics) or with cone ceramic plates with requested thickness. Cone plates are adjusted to diameter of the tube or elbow, which are lined with ceramic.

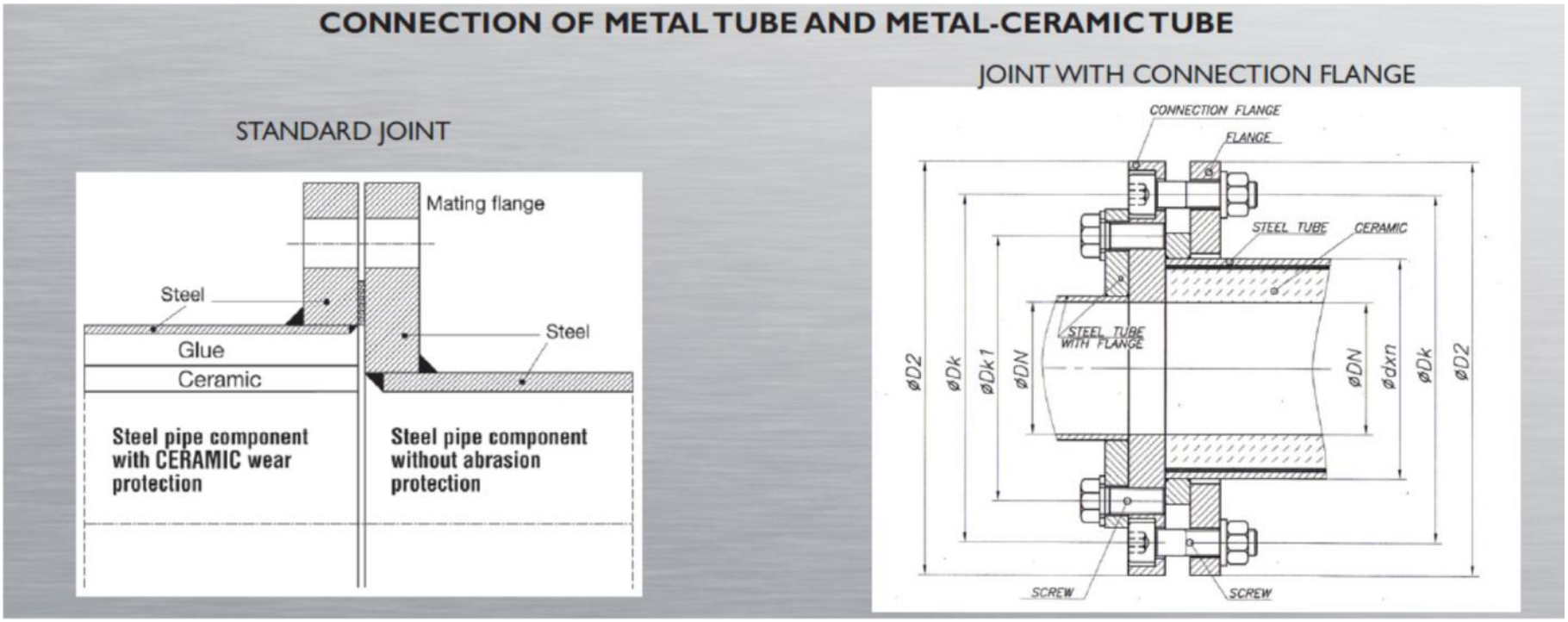
- Wear protection material

CONVEYOR NOZZLE

Conveyor nozzles are used to accelerate transport with injecting the air in very long transport pipelines. These nozzles are made from ceramic segments which have more than 30 inlets around the scope of nozzle. These inlets are directed in the centre of the tube and that provides consistent air pressure of transport media. At the moment, this is the best solution in technology of pneumatic transport.



- Wear protection material



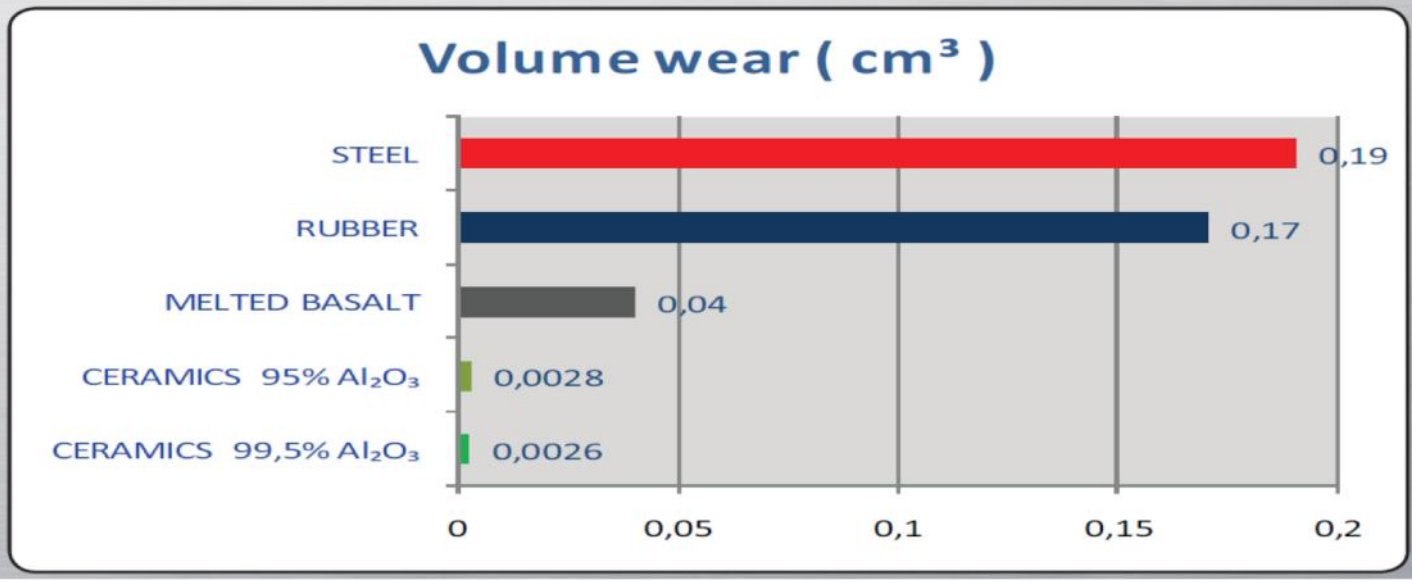
- Wear protection material

WEAR TESTS ON DIFFERENT MATERIALS:

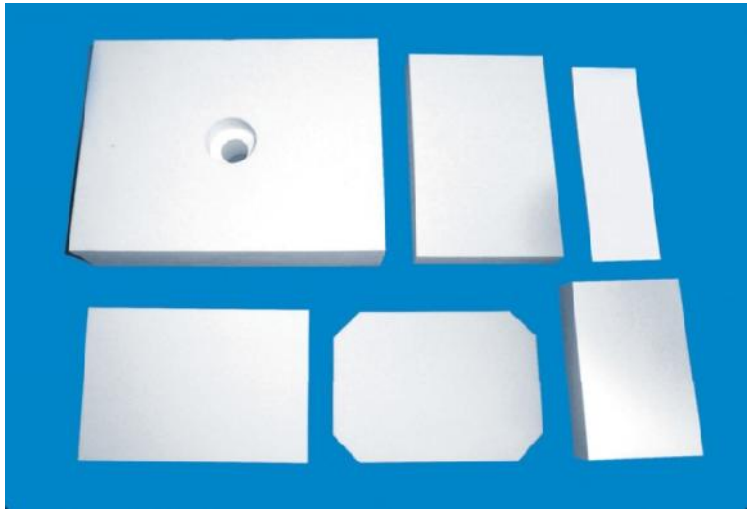
Sample	CERAMICS **99,5% Al_2O_3**	CERAMICS **95% Al_2O_3**	MELTED BASALT	RUBBER	STEEL
Density (gr/cm³)	3,85	3,7	2,95	1,18	7,85
Mass wear (gr)	0,007	0,009	0,12	0,2	1,51
Volume wear (cm³)	**0,0026**	**0,0028**	**0,04**	**0,17**	**0,19**

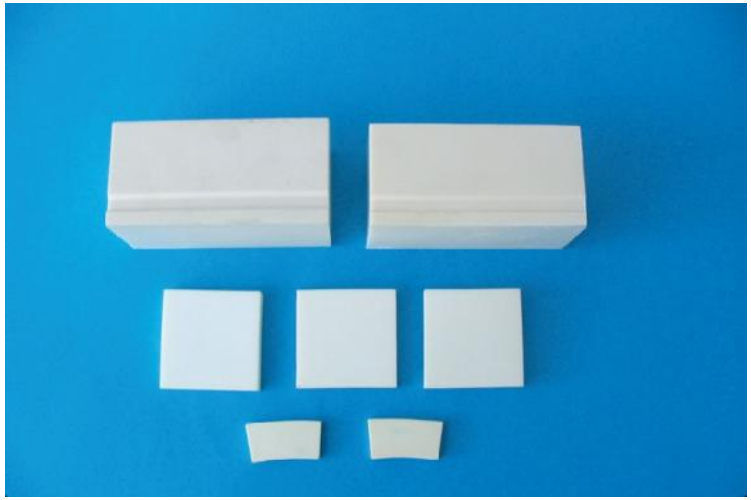
Test is made under following conditions:

- Radiation angle : **30°**
- Pressure : **5 bar**
- Time : **5 minutes**
- Abrasive material : **SiO_2**

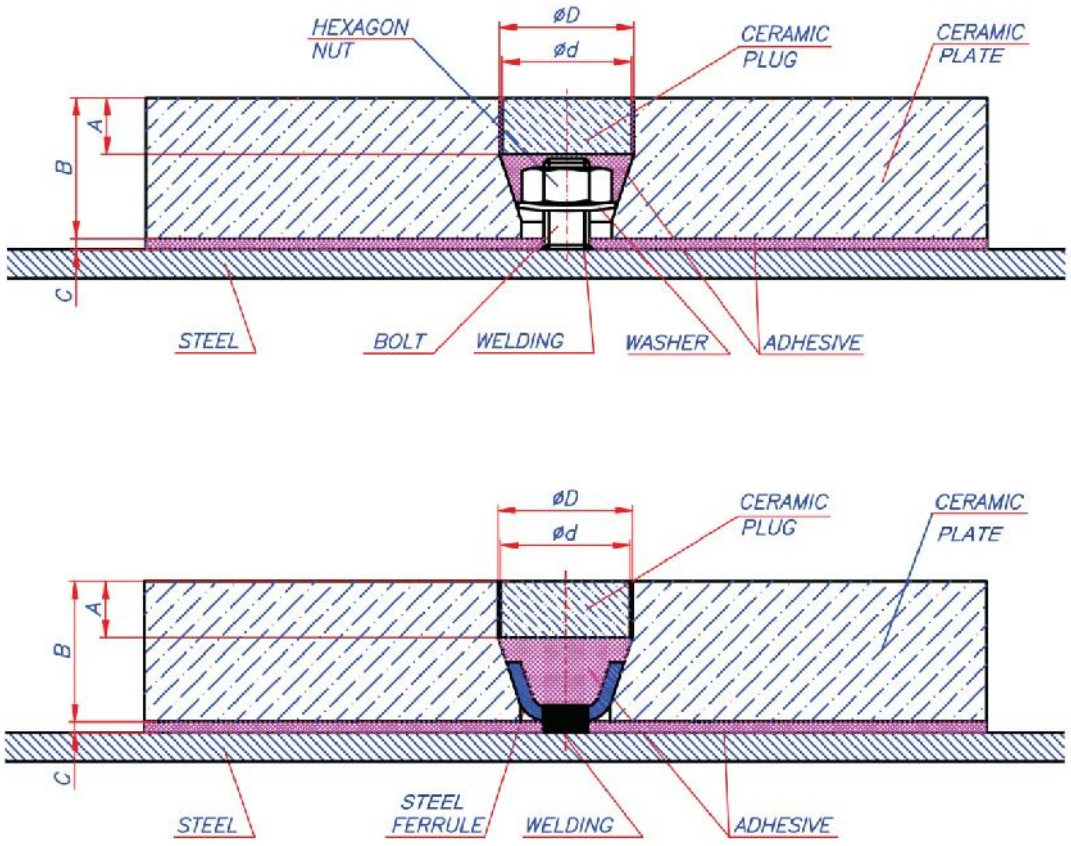


- Wear protection material-lining for large surfaces

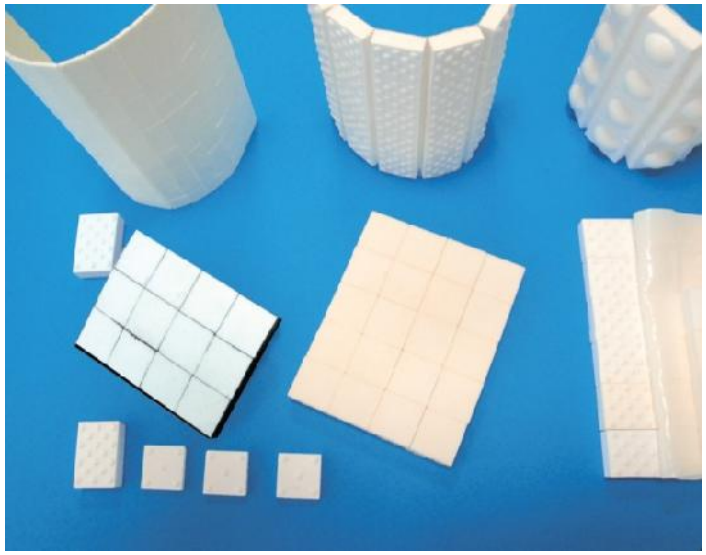


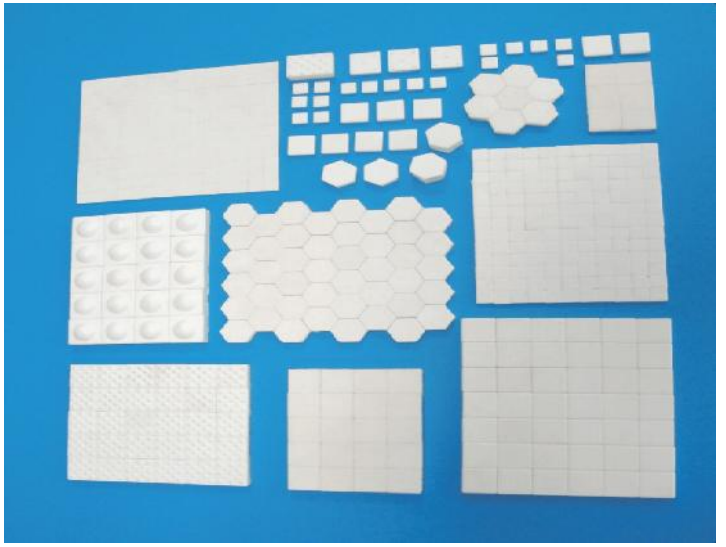


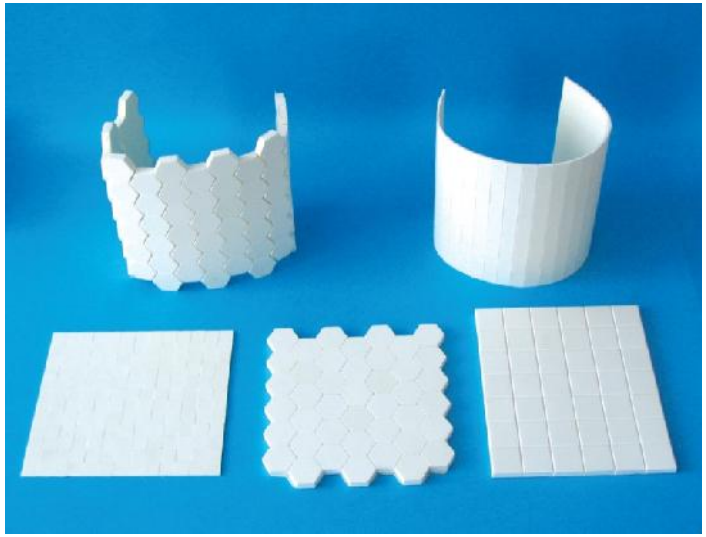
- Wear protection material-adjusting of ceramic plate on surface with welding of steel ferrule

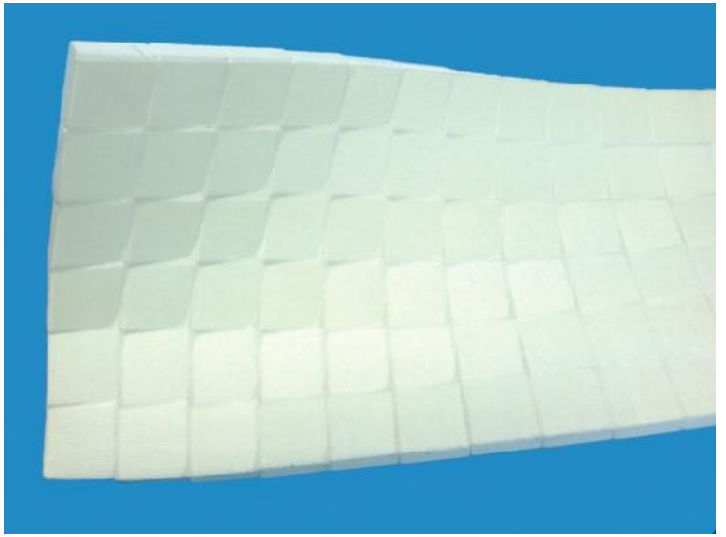


- Wear protection material-MOSAICS









Where to use wear protection material?

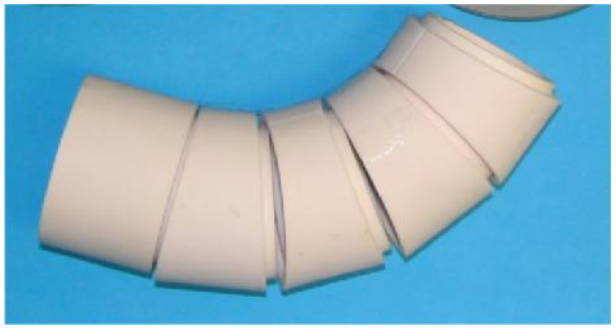
- Hydraulic and pneumatic transportation system
- Steel industry/foundries
- Sugar plants
- Cement plants
- Producers of isolation (glass wool)
- Chemical industry
- Coal mines

Advantages

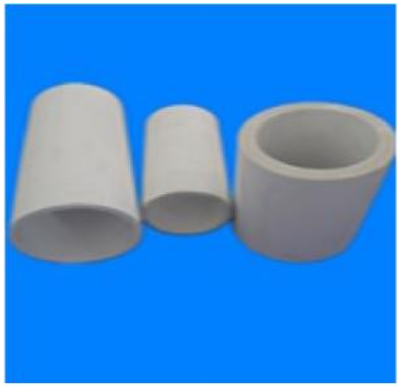
- We are producing our lining for tubes and elbows from high quality 95% Al_2O_3, 99,5% Al_2O_3, $Al_2O_3+ZrO_2$, ZrO_2 etc.
- We are producing our lining with male-female segments
- Our elbows are continuously bended

We vs. competitors

- We are producing our lining for tubes and elbows from high quality 95% Al2O3, 99,5% Al2O3, Al2O3+ZrO2, ZrO2 etc.
- We are producing our lining with male-female segments which makes appearance of homogen part.



- They are using 88%, 90% or maximum 92% Al2O3
- They have flat ceramic segments which allows to material to come behind.



We vs. competitors

- Our metal bends are from one piece. We are bending straight tube to get the bend.

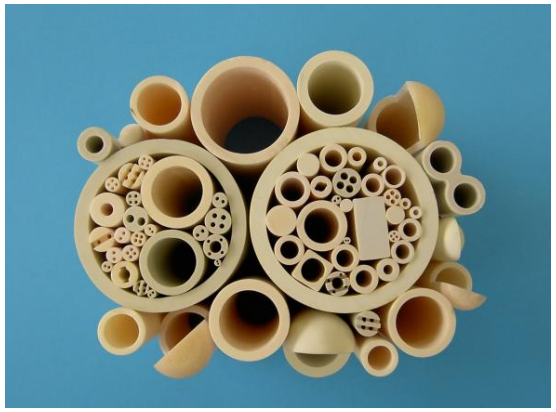
- Competitors are cuting the metal in segments and than welding it again to get the bends. It is not good because the welded parts can

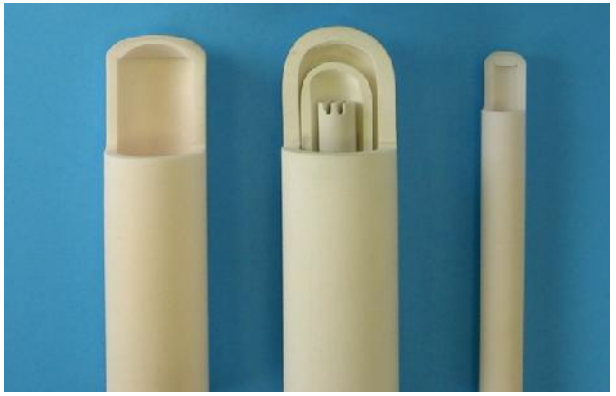
We vs. competitors

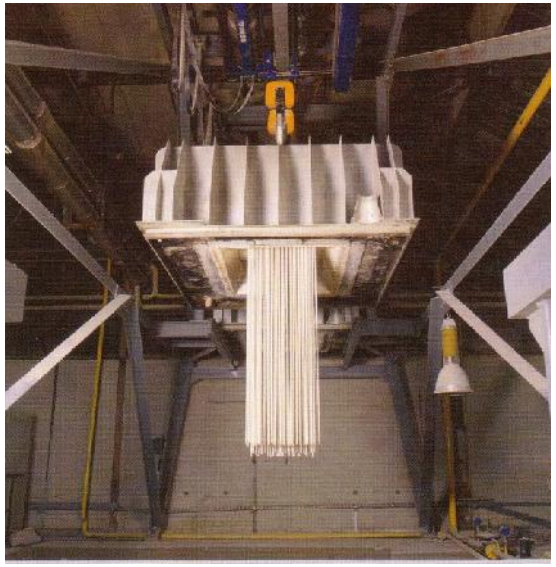
- We have our own material preparation so we can produce special materials for special applications. We can also develop new materials.
- We can produce everything from the beginning to the end product inhouse.

- Our competitors buys already prepared material so they do not have possibility to customize their products for the customers.
- Our copetitors do not have overall production inhouse and they are forced to buy components elsewhere.

- Tubes and isolators for thermocouples





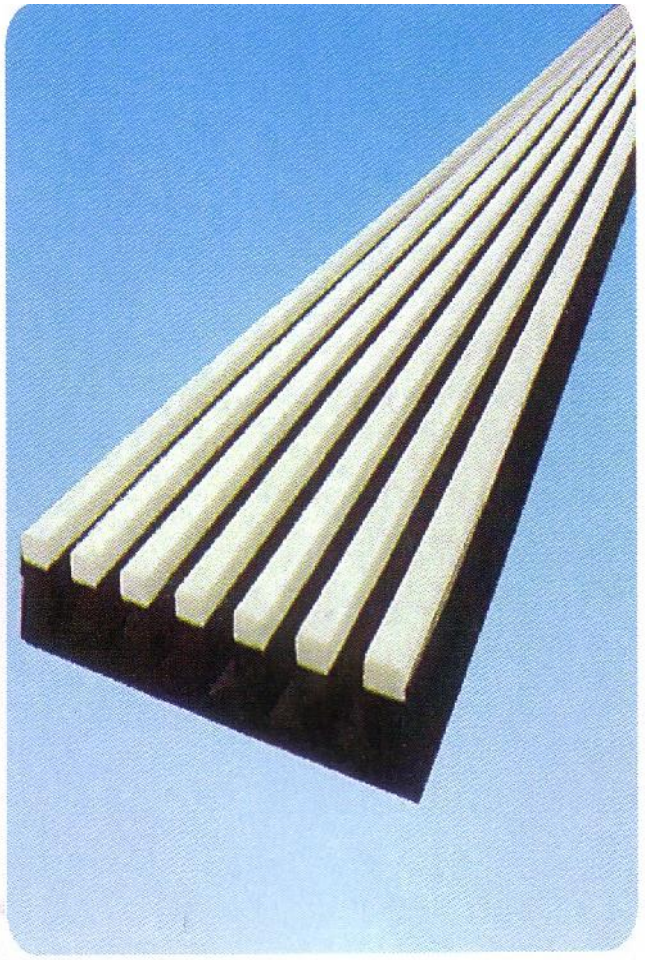


- Tubes and isolators for thermocouples

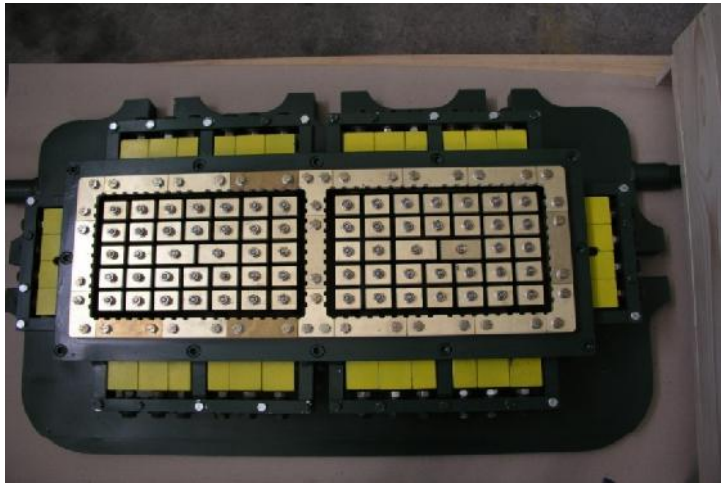
PROPERTY	UNIT	ALUMINA CERAMIC			
Typical application		Tubes for thermoelements resistant to thermal stresses	-insulating tubes for thermoelements -Protection tubes -Insulating rods	-Protection tubes -Insulation rods	-Tubes for thermoelements -Protection tubes -Insulating rods -Tubes for chemical process applications
Type to DIN EN 60672-3		**C 530**	**C 610**	**C 795**	**C 799**
Al_2O_3 - content	%	78	62	95	99,7
Specific gravity	g/cm^3	2,5	2,7	3,68	3,82
Water absorption	%	8 - 12	0	0	0
Hardness	Mohs	6	8	9	9
Modulus of elasticity	GPa		100	280	300
Flexural strenght	N/mm^2	30	120	280	300
Coefficient of linear expansion **20-100 °C** **20-300 °C** **20-600 °C** **20-1000 °C**	$x10^{-6}/°C$	 3,5 - 5 3,5 - 5 4 - 6 4 - 7	 5 – 6 5 – 6 5 – 7 5 - 7	 5 – 7 6 – 7,5 6 – 8 7 - 9	 5 – 7 6 – 8 7 – 8 7 - 9
Specific heat (20 – 100) °C	J/KgK	800 - 900	850 - 1050	850 - 1050	850 - 1050
Thermal conductivity	W/mK	1,4 - 2	4 - 6	16 - 28	19 – 30
Maximum thermal stress	K	350	150	140	150
Dialectric strenght	KV/mm		17	15	17
Max. Temp. use	°C	1500	1500	1550	1650
Chemical resistivity		satisfactory	good	good	very good
Thermal shock resistance		very good	medium to good	medium	medium

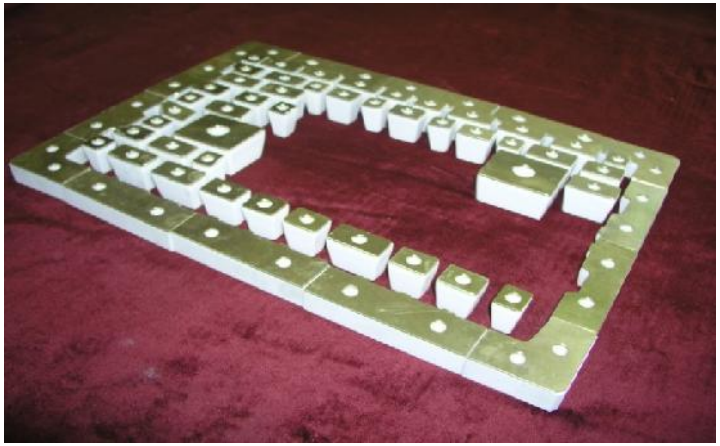
The maximum application temperature depends on the material. The application temperature is also influenced by the tube geometry, the diameter, the wall thickness and the method of application.

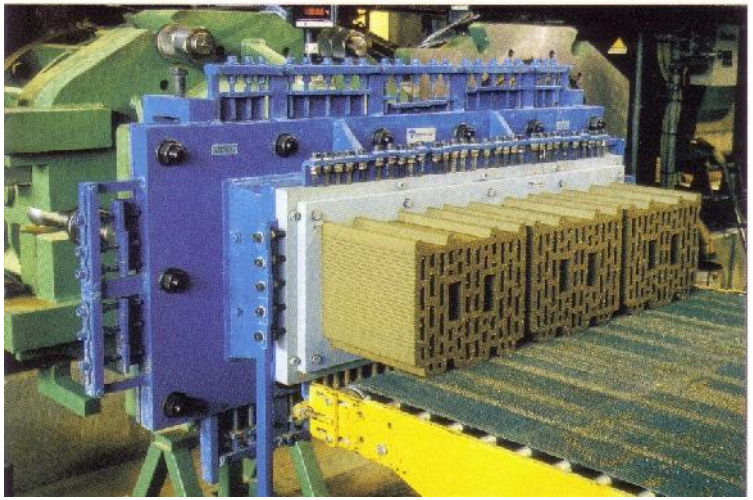
- Ceramics for paper industry and desander



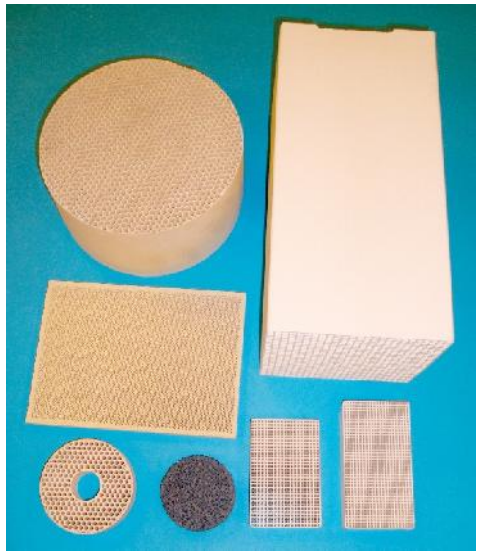
- Ceramics for brick industry

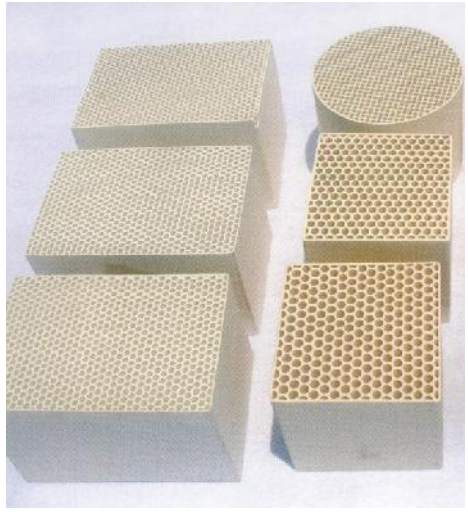


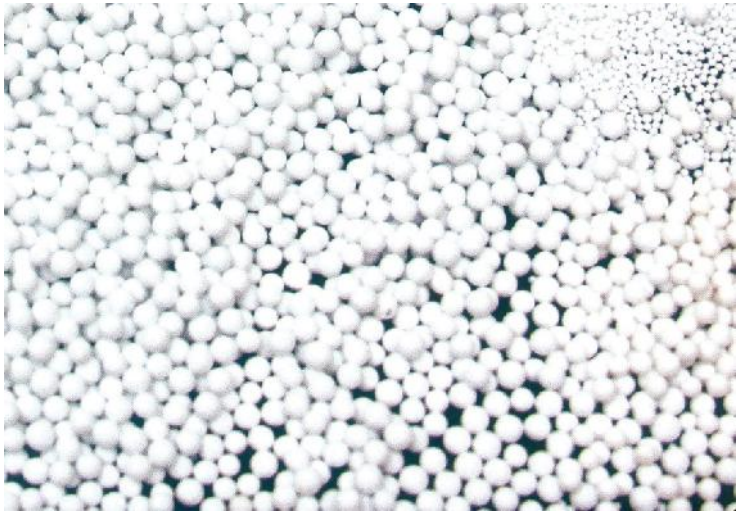




- Ceramic honeycomb filters/heat exchangers







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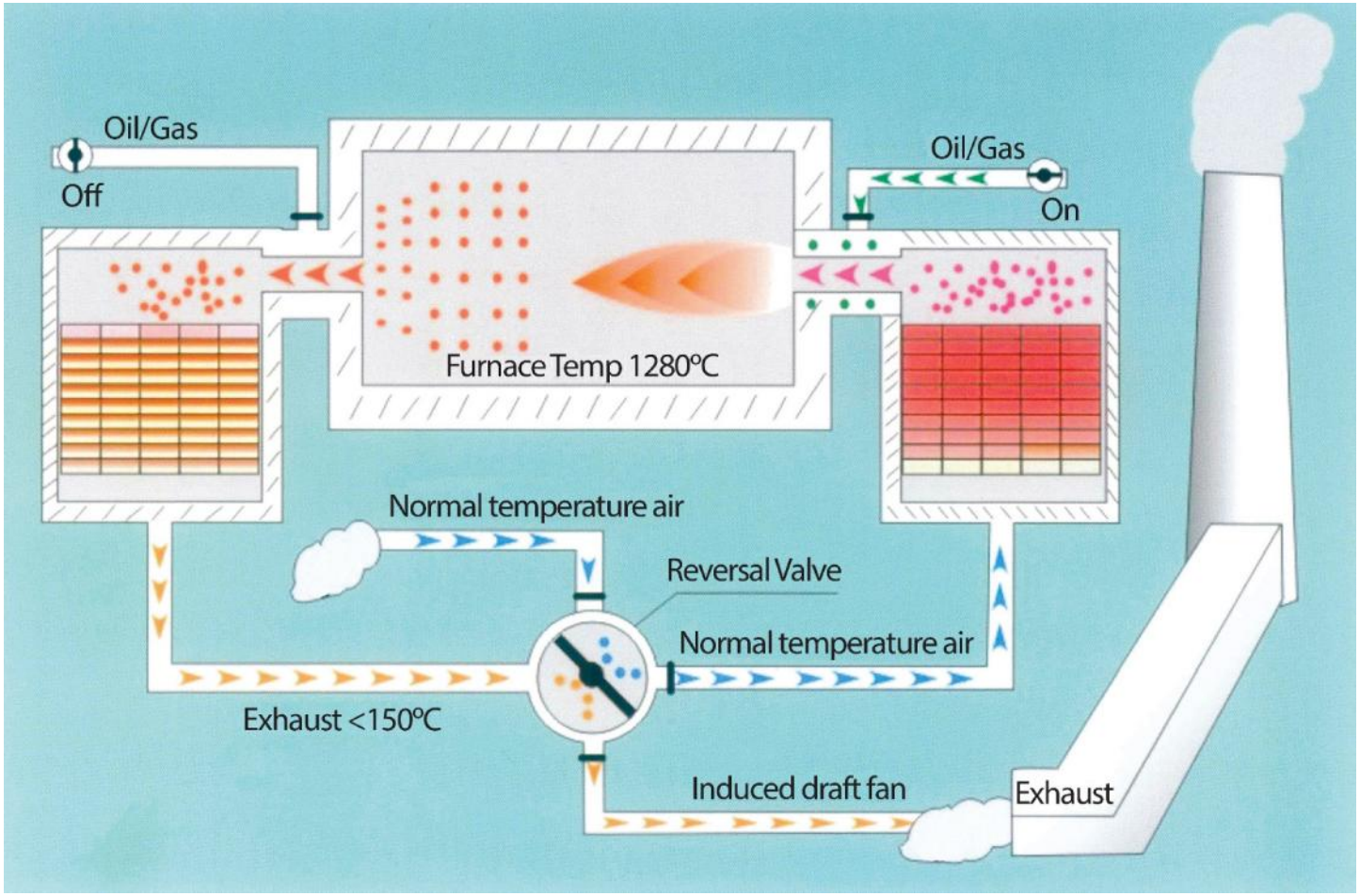
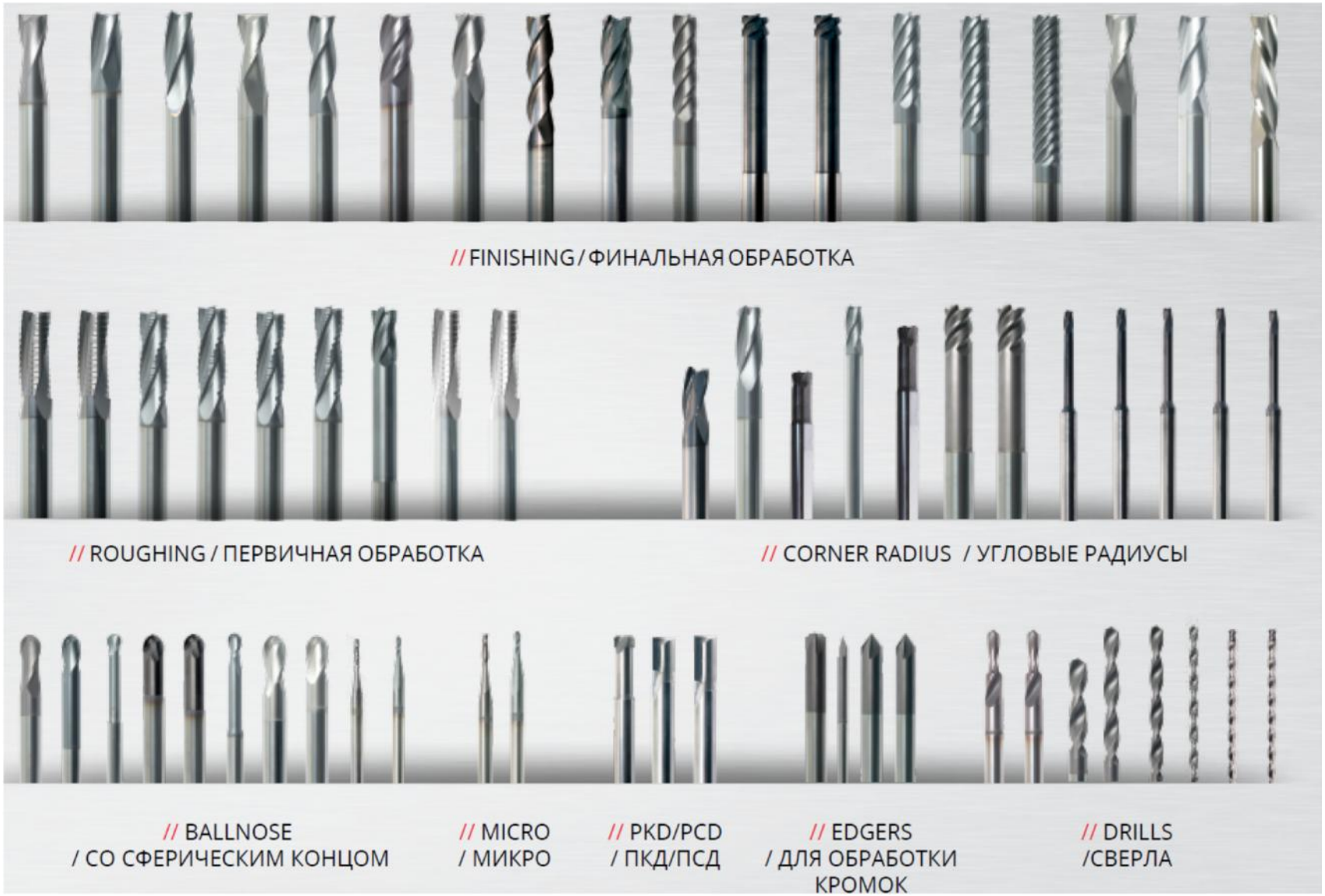


- Tools from hard metal

- Tools from hard metal



WHY TO WORK WITH US?

- We have high quality products
- Wide range of products
- We are flexible supplier
- Short delivery terms
- 95% of our products are custom made

Thank you!