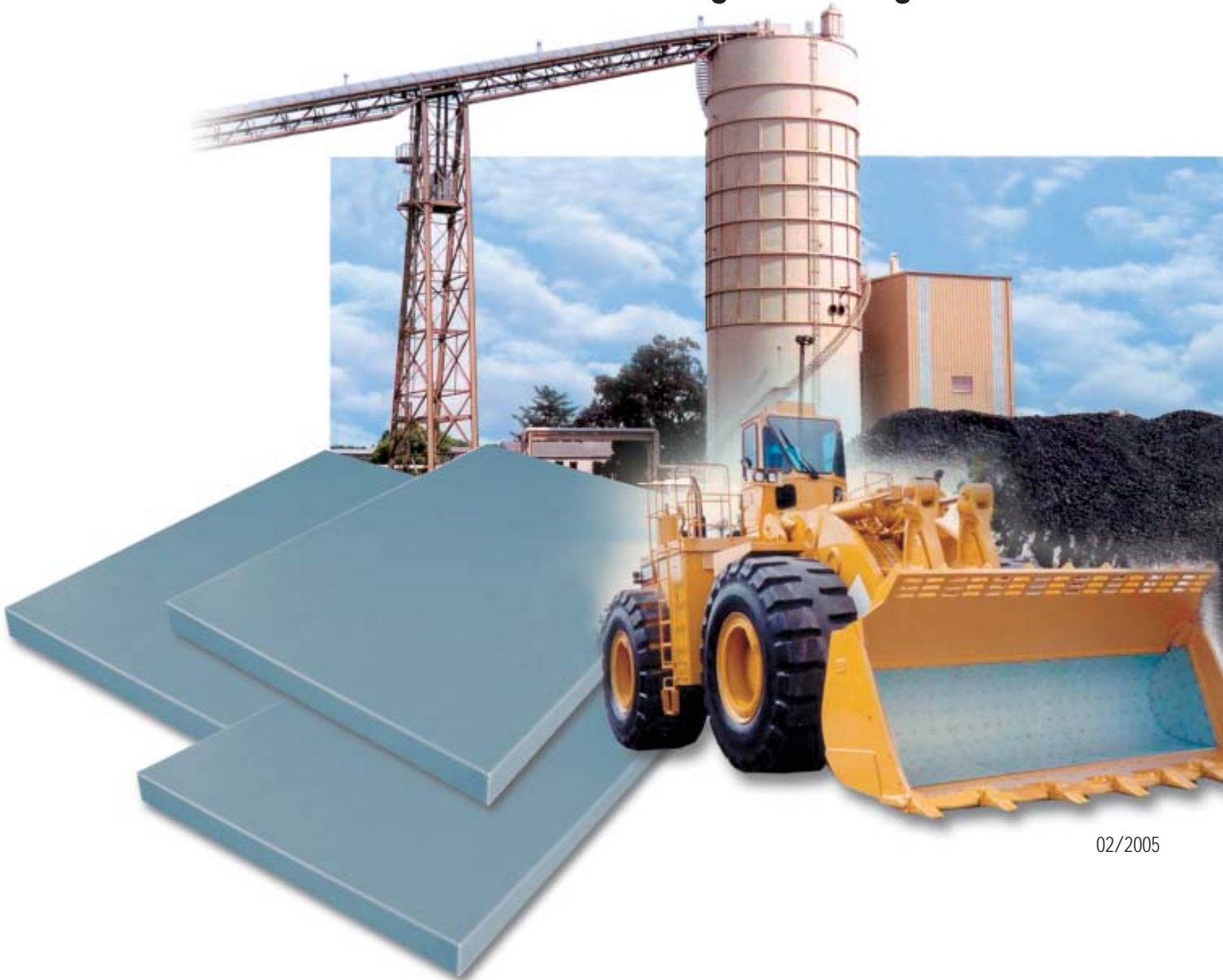


Polystone®
Thermoplastics

Polystone® Matrox™
High performance polymer lining
for bulk material handling and mining



02/2005

Polystone® Matrox™ for lining solutions

Polystone® Matrox™ materials are polymer-engineering plastics that solve the problems of friction, wear and the flow of material in many sectors of the industry.

An exceptional low friction surface, outstanding wear resistance, high impact strength, excellent chemical resistance and superior performance in demanding applications characterize the key properties of the product.



Typical applications

Polystone® Matrox™ is used in a wide variety of industries that handle bulk materials from the mining level up to and including the final processing or use of the product. Changes in moisture and particle size affect the product's flowability. Traditional steel surfaces become rough or corroded causing the bulk material to stick to the steel. The problems get worse and productivity and quality control are compromised.

Mining

- ▶ Off-road truck bed liners
- ▶ Shovel liners
- ▶ Hoppers liners
- ▶ Chute liners
- ▶ Scrapers
- ▶ Stacker/Reclaimer bucket liners
- ▶ Dragline bucket liners
- ▶ Front-end loader buckets

Transportation

- ▶ Ship holds
- ▶ On-road truck bed liners
- ▶ Railcars

Röchling – outstanding competence

Röchling Engineering Plastics is a world-wide leader with nearly 90 years of experience in the development and production of semi-finished products made of engineering plastics. The brand name Polystone® represents one of the world's most comprehensive product ranges of semi-finished products for the capital goods industry. In addition to standard grades, others have been developed in close co-operation with customers that are tailored to the different applications with specific requirements. More than 1,300 highly qualified employees, superior materials development, state-of-the-art production facilities and laboratories are the basis for the high quality and economic efficiency of the products.

Our excellent reputation among the world's leading flow consultants and engineering experts in the field of bulk solids flow has been achieved by earning respect based on providing the industry with unmatched consistent, reliable solutions to flow problems.

Polystone® Matrox™

The new formulation of Polystone® Matrox™ has specifically been developed for the bulk material handling and mining industry to reduce the typical flow problems of bulk solids in bins, hoppers, chutes, truck beds and other applications. Röchling has developed this unique product to provide the best surface friction qualities and abrasion resistance not only to promote bulk material flow but also to withstand the abrasion resistance of flowing bulk materials in rugged applications.

Polystone® Matrox™ is based on a specific formulation of Ultra-High-Molecular Weight Polyethylene that has been developed for the use as a lining-material. The beneficial qualities of Polystone® Matrox™ are the low coefficient of sliding friction as well as high wear-resistance that is required for demanding lining applications in bulk material handling and mining. The life expectancy is comparable to type 304 stainless steel while exhibiting a lower surface friction to promote mass flow. It is used in new construction and as a retrofit to solve bulk solids flow handling problems when other liners fail or do not perform as expected.

Characteristics

- Extremely low surface friction
- Outperforms polished stainless steel to promote flow of bulk materials to increase productivity
- Excellent wear resistance from sliding abrasion
- High impact strength
- Lightweight for easy installation
- No corrosion
- Water repellent (hydrophobic)
- Chemical resistant
- Weldable

Storage and Handling

- ▶ Reclaim hoppers
- ▶ Truck dump hoppers
- ▶ Rail dump hoppers
- ▶ Vibratory feeder pans
- ▶ Receiving Hoppers
- ▶ Dozer Blade Liners
- ▶ Silos, bins, bunkers
- ▶ Slider beds
- ▶ Skirting
- ▶ Belt scrapers

Processing

- ▶ Day bins
- ▶ Surge bins
- ▶ Batch hoppers
- ▶ Storage silos and bins
- ▶ Hoppers
- ▶ Chutes
- ▶ Feeders
- ▶ Screw conveyors

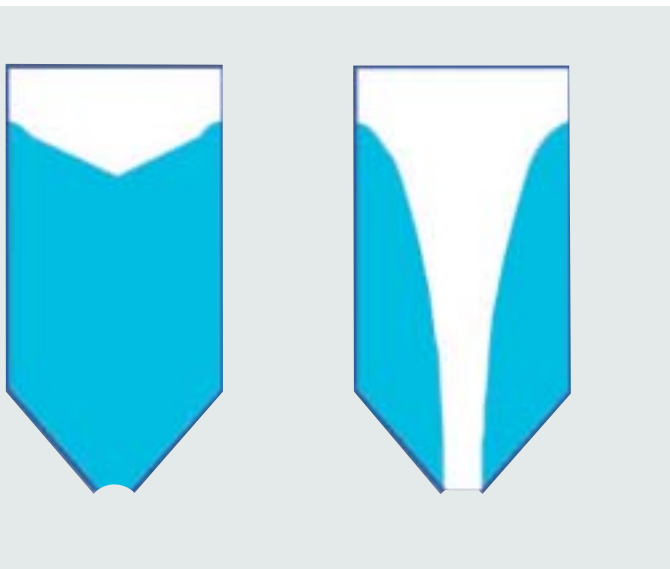
Bulk Materials handled

- ▶ Coal
- ▶ Iron Ore
- ▶ Copper Concentrate
- ▶ Clay
- ▶ Limestone
- ▶ Soda Ash
- ▶ Chemical Powders
- ▶ Nickel Ore
- ▶ Peat
- ▶ Synthetic Gypsum
- ▶ Kaolin Clay
- ▶ Potash
- ▶ Salt
- ▶ Silica Sand
- ▶ Soap Detergent
- ▶ Wood Chips
- ▶ Zinc Concentrate
- ▶ Phosphate
- ▶ Dust
- ▶ Talc
- ▶ Bauxite

Understanding flow problems

Cohesive bulk materials do not flow easily e.g. in chutes and hoppers. They stick to the walls and will affect productivity. This is a common problem because most bins were designed without a thorough knowledge of the bulk material being handled. Moisture, storage time at rest and other factors affect the flow properties of the bulk material.

Arching and ratholes are two common problems that usually develop when either the outlet is too small or when the hopper lining material does not promote flow due to shallow wall angles or rough wall conditions caused by corrosion.



Typical problems: Arches (left) and Ratholes (right) occur when the lining material does not promote the bulk material flow

Segregation will occur if material discharges from the bin in a funnel flow pattern. The center portion of the bin empties first, followed by the material along the walls. This creates segregation because as the bin was loaded the finer particles collect in the center of the bin under the charging point while the coarse particles roll to the periphery of the bin along the walls. In order to remix the material during discharge a mass flow pattern is required to minimize or eliminate segregation.

Polystone® Matrox™ reduces the friction between the bulk material and the walls of the hopper and thus allows the material to flow out and to empty the hopper completely.

Results of flow problems

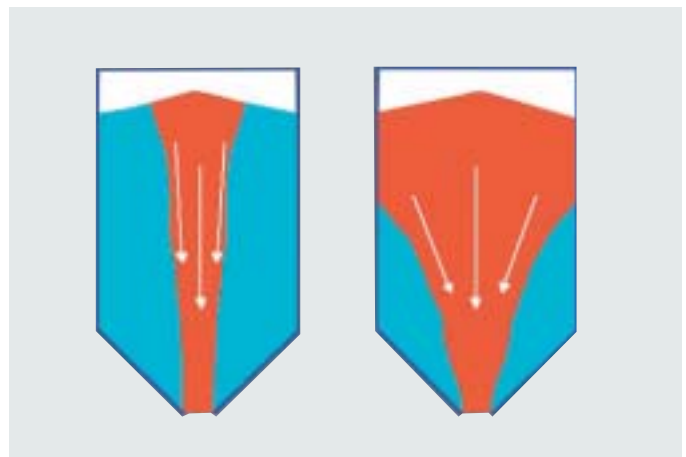
- Delayed start-up - increased cost
- Limited live storage
- Spontaneous combustion (stagnant coal)
- Quality compromised
- Segregation
- Silo vibrating or shaking
- Silo structural failure
- Wear of equipment
- Process out-of control
- Operator intervention

Typical flow patterns

Funnel flow is referred to as first-in last-out and is ideal for free flowing bulk materials. The bulk material discharges from the bin through a small channel in the center of the bin above the outlet and the material along the wall remains stationary until the end.

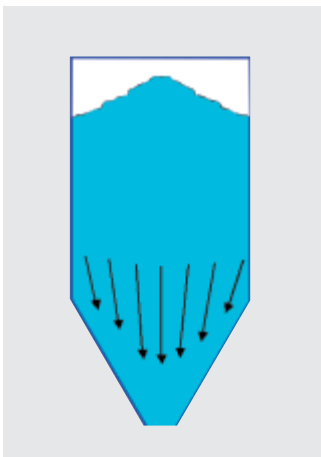


Rathole: The center portion of the bin empties first in the form of a funnel
Photo Courtesy of Solids Handling Technologies, Inc.



Funnel Flow: The flowing material (red) is forming a funnel, while the rest (blue) is sticking to the walls of the bin

Mass flow is referred to as first-in first-out and is required for cohesive bulk materials. It is defined as all the material is in motion whenever any is withdrawn.



Mass Flow: All the material is in motion when any is withdrawn

Recommended cone wall angles to achieve maximum mass flow for different wall materials

Bulk material	Diameter of cone outlet	Flow rate	Wall material		
			Polystone® Matrox™	304 Stainless Steel (w/2B finish)	UHMW-PE
PRB Coal with 29 % moisture	2 ft. (610 mm)	continuous	56°	81°	62°
		after 3 days rest	60°	81°	63°
	8 ft. (2,440 mm)	continuous	55°	78°	60°
		after 3 days rest	59°	78°	62°
PRB Coal with 36 % moisture	2 ft. (610 mm)	continuous	59°	88°	64°
		after 3 days rest	65°	90°	68°
	8 ft. (2,440 mm)	continuous	57°	76°	58°
		after 3 days rest	62°	78°	63°

Summary of wall friction test results from Jenike & Johanson, Inc., PRB is a sub-bituminous coal mined in the USA

Degrees measured from horizontal

Polystone® Matrox™ was tested against various grades of coal with different moisture contents and time at rest (over a weekend). The wall angles required to achieve mass flow vary according to the surface friction of the lining material on the hopper wall.

In order to create mass flow, the hopper walls must be smooth and steep enough and the outlet must be large enough to prevent arching. Please note the different wall angles required to create mass flow in the following chart.

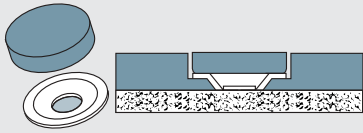
Estimated Wear Life

The following chart shows the estimated life expectancy of a 1/2" (12 mm) thick Polystone® Matrox™ liner in a mass flow circular bin having the following dimensions: total silo height is 65 ft. (1,981.2 cm), hopper section has a 25 ft. (762.0 cm) vertical height, 25 ft diameter with a 2 ft. (60.96 cm) diameter outlet.

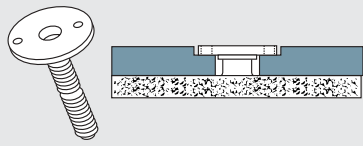
Coal handled	Estimated life of 1/2" (12 mm) thick liner in years
Bituminous	> 17
Sub-Bituminous (PRB)	> 35
Lignite	> 50

Polystone® Matrox™ for lining solutions

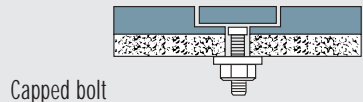
Typical fastening methods



Weld washer



Stud welder



Capped bolt

Solution to Flow Problems

Polystone® Matrox™ is installed by mechanically fastening it to the substrate using bolt-thru or weldable fasteners. Both types are acceptable and are usually chosen based on the requirements of the application and the structure being lined. It is also possible to install the Polystone® Matrox™ liner without fasteners using a drop-in liner concept. The seamless drop-in liner concept is possible with certain applications and can be determined by the installer upon review of the application requirements.

Röchling is associated with many qualified installers around the world that take pride in their work and understand the complex field of bulk material handling. Proper installation by a qualified distributor or installer is critical to the life expectancy of the liner.



Polystone® Matrox™ liner installed in conical hopper



Liner seams are welded



Hopper liner installation



Using a stud welder to attach liner



Large chute lined with Polystone® Matrox™



Front-end loader bucket lined to eliminate sticking



Special welding technique for seams



A metal edge protector prevents the bulk material from getting behind the liner



Material Properties

Technical data	Property	Test method		Unit	Polystone® Matrox™
		ASTM	DIN/ISO		
Mechanical Properties	Density	D 792	ISO 1183	g/cm ³	0,93
	Shore hardness D	D 785	ISO 868	–	63
	Tensile strength at yield	D 638	ISO 527-1	psi	2900
				MPa	20
	Elongation at yield stress	D 638	ISO 527-1	psi	1988
				MPa	14
Elongation at break	D 638	ISO 527-1	%	> 350	
Modulus of elasticity in tension	D 638	ISO 527-1	psi	84000	
			MPa	590	
Thermal Properties	Coefficient of linear expansion	D 696	DIN 52612	K ⁻¹	2 x 10 ⁻⁴
				°F	1.11 x 10 ⁻⁴
Electrical Properties	Surface Resistivity	D 257	DIN VDE 0303	K	>10 ¹⁴
	Volume Resistivity	D 257	DIN VDE 0303	K * cm	>10 ¹⁵
Other Properties	Water absorption	D 570	EN ISO 62	%	< 0,01
	Operating temperature, permanent	–	–	°F (°C)	176 (80)
	Operating temperature, short term	–	–	°F (°C)	266 (130)

Sheet sizes

Polystone® Matrox™ is available in the following sheet sizes:

Polystone® Matrox™	
Dimensions	Thickness
4 x 10 ft 8 x 20 ft MegaSheet™	1/4" – 2"
1,000 x 2,000 mm 3,050 x 1,250 mm 4,000 x 2,000 mm 6,000 x 2,000 mm 6,000 x 2,500 mm MegaSheet™	6 – 50 mm

MegaSheet™

MegaSheet™ is a sheet format especially developed for the lining technology. These sheets are produced in a unique process and have the largest size currently available.

The MegaSheets™ can be utilized either in full size or cut pieces. The large size sheet dimensions allow for fewer seams and more efficient yield.

Benefits of using MegaSheet™

- Size 6,000 x 2,500 mm (20 ft. x 8 ft.)
- Elimination of cost effective processing-steps
- Waste-reduction (better yields)
- Significant cost advantages for the customer

Engineering Plastics and ideas for the future Competence. Performance. Confidence.

The internationally oriented Röchling Engineering Plastics Group has achieved extremely fast growth in the last few years. With Group sales running at more than Euro 229 million it is one of the world's leading suppliers of semi-finished and finished products made of engineering plastics:

- Thermoplastics (PE, PP, PVC, PVDF)
- Composites
- Laminated densified wood

World-wide locations



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Fax + 1 704 922-7651
www.roechling-plastics.us
rep@roechling-plastics.us

Date: _____



Bulk Material Handling Application Data Form

NOTE: To be completed if you require a recommendation from Röchling Engineered Plastics on the usage of MATROX™ lining products in your application.

Company: _____ Contact: _____

Address: _____

City: _____ State: _____ Zip Code: _____ Country: _____

Tel: _____ Fax: _____ E-mail: _____

Bulk Material: _____ Particle size(s): _____ Range of sizes: _____

Moisture Content: _____ % Weight: _____ lb./ft.³ or _____ kg/cm³ Operating Temperature: _____ (✓ or ✓)

Material Characteristics (sharp, angular, hard, soft, cohesive, free-flowing, etc.): _____

Please complete the following section(s) as it applies to your specific application. The more details you can supply result in a more accurate recommendation from us. You should complete a new form for each specific application. It is very important that you answer every question. If you have a problem in completing the form please call us at (704) 922-7814.

Storage Hopper: Discharge rate: _____ tons/hour. Annual throughput: _____ tons/year. Storage capacity: _____ tons.

Frequency of complete discharge: _____ times per _____ Is the bin center loaded? _____ Is there a typical impact zone during charging? _____

Describe impact zone _____ Charging method: (belt conveyor, railcar, truck, etc.) _____

Structural material (steel, concrete, wood, etc.): _____ Is the bin located indoors or outdoors? _____ Is the bin new or existing? _____

Present wall material or liner (be specific): _____ Thickness of wall material or liner: _____

Existing or anticipated problems?: Arching _____ Ratholing _____ Bridging _____ Sticking _____ Is this a continuous problem or seasonal? _____

Please describe why a liner is being considered: _____

Chutes or Transfer Points: Is the problem related to wear or flow? _____ What is the current chute surface material in contact with the bulk material? _____

What is the throughput? _____ tons/hour. Does the current chute surface have to be replaced or repaired? If so, how often? _____

Is there a liner used? _____ What is the liner? _____ Does the bulk material build-up in the chute? _____

Is there an impact zone in the chute? _____ What is the angle of impact between the bulk material and the chute surface? _____

Please describe the problem: _____

Installation: It is highly recommended that MATROX™ Liners are installed by an experienced or certified installation contractor to get the maximum performance and useful life from the material.

Please return this completed form along with a sketch or drawing of the application to:

Röchling Engineered Plastics, Bulk Material Handling Department, PO Box 2729, Gastonia, NC 28053-2729
Tel: (704) 922-7814 or (800) 541-4419 Fax: (704) 922-7651 Email: ken.steppling@roechling-plastics.us