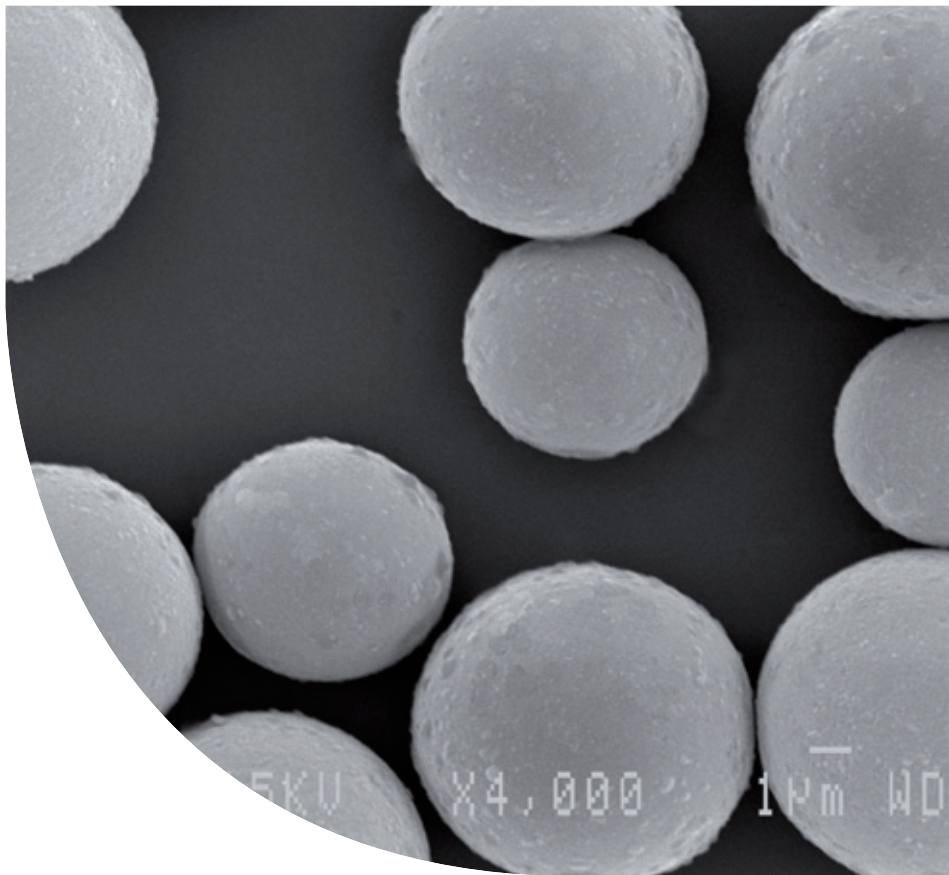




SiliaSphereTM

Spherical Silica Gels



About SiliCycle

Founded in 1995, SiliCycle® Inc. is a worldwide leader in the development, the manufacturing and the commercialization of silica gel products for chromatography, analytical and organic chemistry. With our multi-ton manufacturing capability, we are your partner of choice for all your metal removal, catalysis, synthesis, and purification requirements.

Our business extends to more than fifty countries worldwide and our customer portfolio includes companies in the pharmaceutical, biotechnology industries, contract research and manufacturing organizations as well as university laboratories and hospital research centers.

The mission of SiliCycle is to develop and market innovative silica products of high value to customers and make a technical contribution to their work.

At SiliCycle, we are at the forefront of the chromatography industry, owing to the extraordinary purity of our silica gels and our capacity to rapidly adapt these gels to meet the specific requirements of pharmaceutical professionals and university scientists.

We lead the way in offering innovative products, such as SiliaCat® heterogeneous catalysts, SiliaMetS® Metal Scavengers, SiliaBond® functionalized silica gels, SiliaFlash® Irregular silica gels, IMPAQ® angular silica gels, SiliaSphere™ spherical silica gels, SiliaSep™ flash cartridges, SiliaPrep™ SPEs and Well Plates, SiliaPlate™ TLC plates, and SiliaChrom® HPLC columns.

We offer a wide variety of first-rate Ultra Pure Silica Gels. Our automated manufacturing process, which includes acid washing and multiple analyses, is continuously optimized to ensure high purity and a low percentage of fine particles, thereby guaranteeing optimal performance.

We are committed to provide the highest quality products and services in the industry.



Importance of Quality Control

The Quality Control Department's objective is to provide defect-free products. In light of this goal, we have determined the critical points that need to be addressed for each product line. These points are based on customer's and Account Managers' recommendations as well as on our employees' scientific knowledge.

Each product family has its own quality control procedures, which are strictly adhered to. QC test results are checked and confirmed by the person in charge of them before being cleared for shipping. Complete procedures for each product line are available upon request.

Thus, SiliCycle is committed to high quality standards. In doing so, every product meets the quality specifications our customers demand. All products are shipped with a Certificate of Analysis (CofA) and a sample from every batch is kept for subsequent analysis. If you feel that the product you have received does not meet these specifications, please contact us and we will make sure you are satisfied.

Bare Silica Gel

The backbone of most of SiliCycle's products is SiliFlash F60 (40-63 μm , 60 \AA) silica gel. It provides superior performance for chromatographic applications due to its narrow particle size distribution and high purity.

Before functionalization, every silica is rigorously characterized and analyzed by the procedures below to ensure lot-to-lot reproducibility.

Functionalized Silica Gel

The process for functionalizing the silica is highly dependent on the group being attached. However, it is still possible to functionalize 90% of the surface, verified by ^{29}Si MAS NMR. The remaining 10% of the surface may be endcapped to provide a completely inert support. After being functionalized, the product is submitted to further analysis and quality control as outlined below.

Quality Control	
Type of Analysis	Performed by:
Bare Silica Gel	
Carbon, nitrogen & sulfur content	Elemental analyzer
Total trace metal	ICP-OES
Surface area & porosity	Nitrogen adsorption analyzer
Particle size distribution	Laser light diffraction
Tapped density analysis	Density measurement
Water content	Moisture balance
pH	pH-meter
Functionalized Silica Gel	
Residual solvent content	Moisture balance
Specific reactivity analysis	GC-FID, GC-MS, LC-MS/MS, ICP-OES
Organic function signature	Infrared spectroscopy
Purity analysis	GC-MS



Analysis Descriptions

Elemental Analysis of Organic Compounds

SiliFlash silica gel has a very low organic content. All lots are subjected to elemental analysis to determine the carbon, nitrogen and sulfur levels.

Total Trace Metal Analysis

To improve the quality of the separation, SiliCycle manufactures silica gels with very low traces of metal content. All silica gels are analyzed for more than 45 metals by ICP-OES down to ppm, and reach up to 99.4% silica purity. This removes any issues from metal oxides that may act as Lewis acids and prevents «Tailing» of most polar compounds (*frequently ionizable*) that can be caused by silica with a high metal content.

Surface Area and Porosity Analysis

The efficiency and reliability of silica gel depend on its surface condition. We use the Brunauer, Emmet, and Teller analysis to determine the surface area, and the Barret-Joyner-Hatenda method to determine the pore diameter and pore volume. A larger surface area results in more contact or interaction with the analyte, thereby increasing the segregation of different products. Pore diameter and pore volume permit semi-exclusion chromatography where smaller molecules fit into pores more easily than larger ones. This justifies the use of several types of silica to achieve better discrimination in chromatographic separations.

Particle Size Distribution Analysis

Particle size distribution is determined by laser diffraction. Usually, more than 90% of the silica gel is kept within the appropriate range.

Water Content Analysis (*silica gel activity*)

The amount of water on the silica's surface affects chromatographic performance. An anhydrous silica gel will be extremely polar, while a wetted one will be considerably less polar. Every batch is carefully adjusted to a specific percentage of water content.

pH Analysis

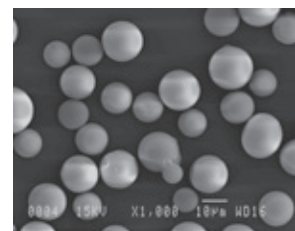
The pH can increase the retention of some ionizable compounds. However, some products can become hydrolyzed or rearranged when in contact with acidic silica. A neutral pH, with a range between 6.5 and 7.5, is the most important factor in determining the reliability and inert behavior of the silica. This pH test involves suspending the silica gel in pure water (5% w/w).



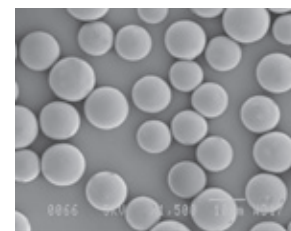
SiliaSphere Spherical Silica Gel

SiliCycle is your partner of choice for your purification and chromatography needs.

- SiliCycle has improved large-scale production of its SiliaSphere spherical silica support. You will be happy to see that the quality is superior due to a narrower particle size distribution.
- SiliaSphere spherical silica gels present great advantages for your preparative chromatography applications.



Old version
S10007G



New version
S10007G-A

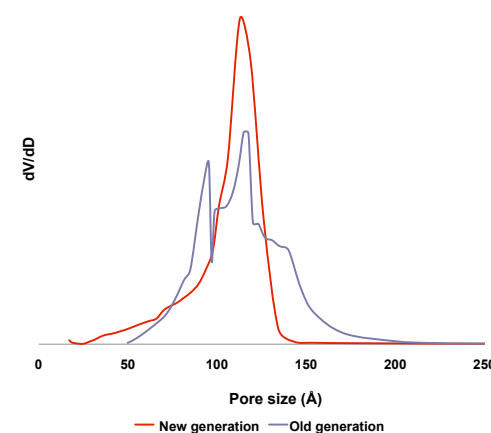
SEM picture of 10 μm

SiliaSphere Monodispersed Spherical Silica Gels

Our SiliaSphere family of silicas are monodispersed spherical silica gels with particle sizes from 1.8 to 15 μm . The 1.8, 2.2, 3, and 5 μm gels are used in analytical scale chromatography. The 10 and 15 μm gels are used in preparative chromatography. Available in 60, 80, 100, 120 and 300 \AA pore sizes.

Our SiliaSphere are characterized by low metal content to avoid specific interaction between acid sites and analytes as well as high mechanical stability and very high purity.

The SiliaSphere are manufactured from an organic form of silicon (alkoxydes). This ensures very low metal content as the starting material is purified by distillation. Deionized water is used to hydrolyze the silicon alkoxydes. Careful monitoring and control of the parameters that induce precipitation afford spherical silica gels with the desired characteristics.



The SiliaSphere family is characterized by a very low metal content and exceptionally stable at the low or high pH. The SiliaSphere manufacturing process ensures quality and reproducibility in pore size, surface area and particles sizes and morphology. The high specific surface area enables a high loading capacity with a uniform and reproducible coverage.

Please note that we are able to provide all our functionalized products (C18, C8, amine, cyano, diol, etc.) on any spherical silica gel presented in this catalog. Contact us for details!

SiliaSphere Product Overview

SiliaSphere Monodispersed Spherical Silica Gels				
Product Number	Particle Size (μm) D50	Pore Diameter (\AA)	Pore Volume (mL/g) / Spec. Surf. Area (m ² /g)	BONDED C18 mono Product Number
BARE SiliaSphere Monodispersed Spherical Silica				C18 mono
S10007B-A	10	60	0.85 - 1.15 / ≥ 600	S03207B-A
S10008B-A	15	60	0.85 - 1.15 / ≥ 600	S03208B-A
S10003F-A	3	80	0.85 - 1.15 / ≥ 450	S03203F-A
S10005F-A	5	80	0.85 - 1.15 / ≥ 450	S03205F-A
S10007F-A	10	80	0.85 - 1.15 / ≥ 450	S03207F-A
S10008F-A	15	80	0.85 - 1.15 / ≥ 450	S03208F-A
S10003E-A	3	100	0.85 - 1.15 / ≥ 400	S03203E-A
S10005E-A	5	100	0.85 - 1.15 / ≥ 400	S03205E-A
S10007E-A	10	100	0.85 - 1.15 / ≥ 400	S03207E-A
S10008E-A	15	100	0.85 - 1.15 / ≥ 400	S03208E-A
S10001G-A	1.8	120	0.85 - 1.15 / ≥ 300	S03201G-A
S10002G-A	2.2	120	0.85 - 1.15 / ≥ 300	S03202G-A
S10003G-A	3	120	0.85 - 1.15 / ≥ 300	S03203G-A
S10005G-A	5	120	0.85 - 1.15 / ≥ 300	S03205G-A
S10007G-A	10	120	0.85 - 1.15 / ≥ 300	S03207G-A
S10008G-A	15	120	0.85 - 1.15 / ≥ 300	S03208G-A
S10003M	3	300	0.75 - 1.05 / ≥ 80	S03203M
S10005M	5	300	0.75 - 1.05 / ≥ 80	S03205M
S10007M	10	300	0.75 - 1.05 / ≥ 80	S03207M
S10008M	15	300	0.75 - 1.05 / ≥ 80	S03208M
S10007T	10	1,000	0.75 - 1.05 / ≥ 20	S03207T
S10008T	15	1,000	0.75 - 1.05 / ≥ 20	S03208T

pH (5% w/w): 4 - 7, Volatile content: ≤ 10
Formats: 100g, 500g, 1kg, 5kg, 10kg, 25kg, ... up to multi-ton scale

SiliaSphere PC (Preparative Chromatography)

Cost is very important in preparative and process chromatography, and the use of spherical particles with narrow particle size distribution is very expensive. It is possible in this case to use irregular or angular silica but the separation may not provide the desired results. For these situations, SiliCycle has developed a second class of spherical silica particles for preparative chromatography. The advantage of using SiliaSphere PC materials over standard silica gels includes the following:

- Increased efficiency of the eluent's flow characteristics
- Improvement of the resolution between compounds of a sample
- Ease of packing

SiliaSphere for Preparative Chromatography

Product Number	Particle Size (µm) D50	Pore Diameter (Å)	Surface Area (m ² /g)	Product Number	Particle Size (µm) D50	Pore Diameter (Å)	Surface Area (m ² /g)
S10030B-A	50	60	≥ 650	S10020M	30	300	≥ 100
S10034B-A	75	60	≥ 650	S10030M	60	300	≥ 100
S10040B-A	100	60	≥ 650	S10040M	100	300	≥ 100
S10063B-A	150	60	≥ 650	S10020T	30	1,000	≥ 50
S10030G-A	50	150	≥ 290	S10030T	60	1,000	≥ 50
S10040G-A	100	150	≥ 290	S10040T	100	1,000	≥ 50

Formats : 250g, 1kg, 5kg, 10kg, 25kg, ... up to multi-ton scale

IMPAQ Angular Silica Gels

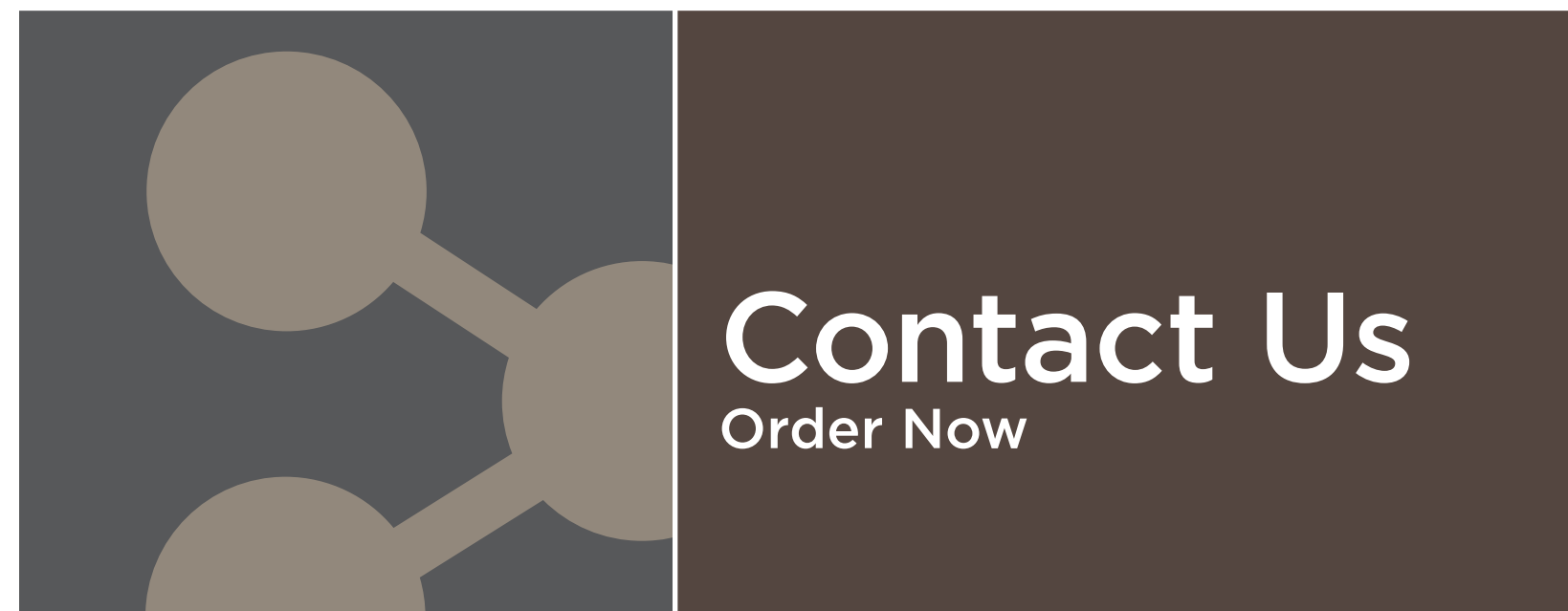
The IMPAQ angular silica gels are a good alternative to spherical material for preparative applications as they provide very efficient separations at a much lower price. IMPAQ is premium-grade angular silica designed for preparative chromatography where consistent

high purity and narrow particle distribution and pore dimension are required. IMPAQ is a porous silica gel in which the surface area, porosity and rigidity have been optimized for loading capacity and mechanical stability.

IMPAQ for Preparative Chromatography

Product Number	Particle Size Distribution (µm)		Pore Diameter (Å)	Pore Volume (mL/g)	Spec. Surface Area (m ² /g)	pH (5% w/w)
	D50	D10/D90				
B10007B	10 µm	≤ 1.8	60	0.70 - 0.85	≥ 450	≥ 4
B10009B	20 µm	≤ 1.8	60	0.70 - 0.85	≥ 450	≥ 4
B10025B	40 µm	≤ 2.1	60	0.70 - 0.85	≥ 450	≥ 4
B10007E	10 µm	≤ 1.8	100	1.0 - 1.4	≥ 400	≥ 6
B10009E	20 µm	≤ 1.8	100	1.0 - 1.4	≥ 400	≥ 6
B10025E	40 µm	≤ 2.1	100	1.0 - 1.4	≥ 400	≥ 6

Formats : 100g, 1kg, 5kg, 10kg, 25kg, ... up to multi-ton scale



Ordering Information

Quote Form

General Information

Company:

SiliCycle Customer Number (if known):

Contact Name:

E-mail address:

Tel: Fax:

Address Information

.....

Department:

Address:

ZIP/Postal Code:

Country:

Quote Request		
Part Number	Product Description	Request Quantity

Confirm this request by

- FAX
- E-mail
- Phone

Comments

.....

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Information Request Form

Metal Scavengers
Metal of interest:

Catalysts
 SiliaCat catalysts
 SiliaBond catalysts
 SiliaCat + SiliaBond catalysts

Oxidants
 SiliaCat oxidant
 SiliaBond oxidants
 SiliaCat + SiliaBond oxidants

Organic scavengers
 Nucleophile scavengers
 Electrophile scavengers
 Genotoxic scavengers

SiliaBond Reagents
 Reaction of interest

Others

Chromatographic phases
 Reversed phases
 Normal phases
 Fluorous phases
 Ion exchangers

HPLC Columns
 Reversed phases
 Normal phases
 Ion exchangers
 Chiral phases

Application notes in
 Bulk
 SPE cartridges
 Flash cartridges

General Information

Company:

SiliCycle Customer Number (if known):

Contact Name:

E-mail address:

Tel: Fax:

Address Information

.....

Department:

Address:

ZIP/Postal Code:

Country:

Comments

.....

.....

..... Please Copy and Fax this form to SiliCycle Inc. at **418-874-0355**



Order Form

General Information

Company:
 SiliCycle Client Number: Purchase Order Number:
 Contact Name:
 E-mail address:
 Tel: Fax:

Payment Details

Verification Code*

Credit card number: *The 3 last numbers in the back side of your card
 Expiry date:
 Name as it appears on card:
 VISA Master Card Amex

Address Information for the Shipment

Department:
 Address:
 ZIP/Postal Code:
 Country:

SiliCycle Products				
Part Number	Product Description	Packaging (g, Kg, box)	Quantity	Price (USD)

Confirm this request by

- FAX
- E-mail
- Phone

Comments

.....
 Please Copy and Fax this form to SiliCycle Inc. at **418-874-0355**

Ordering Information

How to order

You can order any SiliCycle product on-line through the new SiliCycle e-commerce website: www.silicycle.com.

You can also order any product from this catalog, 365 days or nights a year. We hope you will enjoy this new and friendly way to order SiliCycle products.

Orders can also be placed by phone, fax, mail or e-mail. You will find an order form on page 222 of this catalog for fax (1 418.874.0355) and mail (SiliCycle headquarters address at the bottom of this page) orders. If you prefer, you can reach us by e-mail (info@silicycle.com) or by phone (1 418.874.0054 or Toll free for North America only 1 877.745.4292). Please have the following information on hand:

- Your name
- Company name, billing and shipping address
- Purchase order number
- Credit card information
- Catalog number and product description
- Size, quantity and unit of measure
- E.I.N. or F.I.N .for United States clients

Technical Support

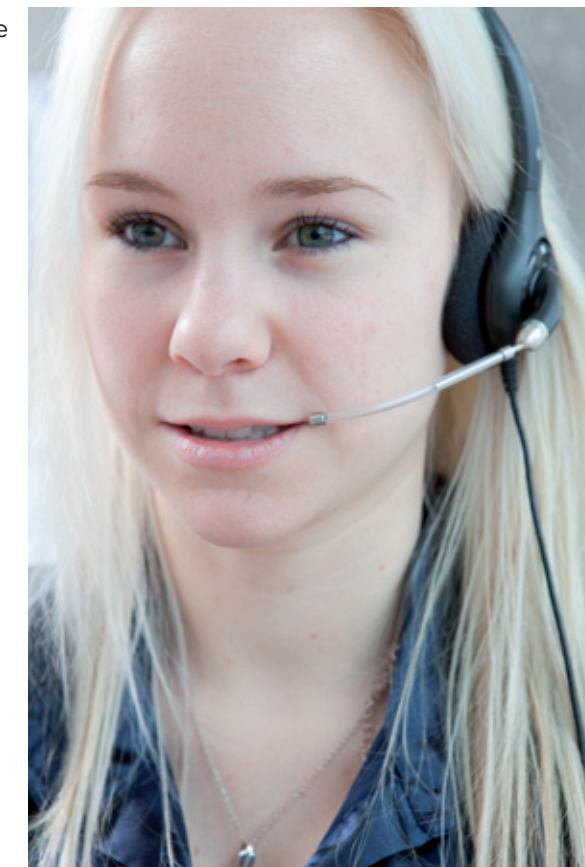
At SiliCycle, we are committed to providing the best technical support possible. Our worldwide Technical Support Group is comprised of a team of highly qualified M.Sc., Engineers and PhD Chemists, Technical Support Professionals and Service Coordinators who are prepared to troubleshoot, answer questions, and provide solutions for your service and applications needs.

In order to better respond to your technical inquiries, feel free to contact us in three different ways:

- E-mail: support@silicycle.com
- Phone: International 1 418.874.0054
- Canada USA 1 877.745.4292 (Toll-Free)
- Online forum at www.SiliCycle.com

SiliCycle headquarters address:

2500, Parc-Technologique Blvd
 Quebec City, Quebec
 G1P 4S6, CANADA



Terms and Conditions

General

Unless otherwise stated, all transactions are expressly subject to these Terms and Conditions. Modifications or additions will be recognized only if accepted in writing by an officer of SiliCycle Inc. (*hereinafter named SiliCycle*), or an officially designated representative. Provisions of Buyer's Purchase Order or other documents that add to or differ from these Terms and Conditions are expressly rejected. No waiver of these Terms and Conditions or acceptance of others shall be construed as failure of the Company to raise objections.

Privacy Policy

Because your clientele is our most vital asset, we take privacy very seriously and won't share your personal information with anyone. Your information is used only to personalize your profile and to facilitate the transaction. You can change or update your information at any time.

Quotation and Published Prices

Quotations automatically expire 30 calendar days from the date issued unless otherwise stated. Quotes are subject to withdrawal with notice within that period. Prices shown on the published price lists and other published literature issued by SiliCycle are not unconditional offers to sell, and are subject to change without notice.

Warranty

SiliCycle guarantees to the original Buyer that the products sold conform to the composition and purity described therein at the time of their shipment. The Buyer's sole remedy in the event that SiliCycle fails to meet said warranty shall be the replacement of the unused portion of the product(s), or if approved by SiliCycle, a refund (*at the purchase price*) provided that the Buyer returns the alleged non-conforming product(s) within 30 days after reception of product(s). SiliCycle makes no other guarantee of suitability for a particular purpose or of the merchantability in the use or handling of the product, and does not accept any liability for consequential, special, indirect or incidental damages resulting therefrom.

Changes

The Buyer may, with the express written consent of SiliCycle, make changes in the specifications for products or work covered by the contract. In such an event, the contract price and delivery dates shall be equitably adjusted. SiliCycle shall be entitled to payment for reasonable profit plus costs and expenses incurred by work and materials rendered unnecessary as a result of such changes and for work and materials required to effect said changes.

If the Buyer has made a mistake on his/her purchase order, and the material has already been shipped and received, SiliCycle may approve the exchange of said material (*if price is identical*); however the Buyer will be responsible for all shipping costs. See return authorization policy section on the next page to obtain a return merchandise authorization form prior to returning goods.

Cancellation

Undelivered parts of any order may be cancelled by the Buyer only with the written approval of SiliCycle. If the Buyer makes an assignment for the benefit of creditors, or in the event that SiliCycle, for any reason feels insecure about Buyer's willingness or ability to perform, SiliCycle shall have the unconditional right to cancel the sales transaction or demand full or partial payment.

In the event of any cancellation of this order by either party, the Buyer shall pay SiliCycle for reasonable costs and expenses incurred by the SiliCycle prior to receipt of the cancellation notice, plus SiliCycle's usual rate of profit for similar work.

Taxes

The Company's prices do not include any applicable sales, goods and services, use, excise or similar taxes and the amount of any such tax SiliCycle may be required to pay or collect will be added to each invoice and paid by the Buyer.

Terms of Payment

All merchandise purchased remains the property of SiliCycle until such time as all invoices for the merchandise have been paid in full. Except for purchases paid online, or unless explicitly stated elsewhere in writing, terms are cash net 30 days from date of invoice. Additional fees of 2% per month (26.8% per year) will accrue on all accounts past due. If any payment is in default, and it becomes necessary to hire a recovery agency or lawyer, the client accepts to pay, in addition to the outstanding balance, recovery fees equal to 20% of the balance in capital and interests. By reason of the financial condition of Buyer or otherwise, SiliCycle may require full or partial payment in advance.

Certain orders may require a deposit or progressive payments as referenced in the quote. Such deposits may be increased upon receipt of purchase order based upon the Buyer's most current credit rating. Subject to the warranties stated in this policy, all sales are final without right of return.

Return Policy

Our Customer Service Department is available to assist you at any time should a problem arise with your order. Please make sure to inspect your packages immediately upon receipt and notify us within the next two (2) business days of any damage and/or discrepancies. Should a product be sent to you incorrectly, as the result of an error on our part, we will take quick and appropriate action to correct the problem at no charge to you.

In order to maintain the quality of our products and continue to provide competitive prices, some products may not be returned for credit. SiliCycle will not grant credit for:

- (i) Shelf-worn, used or defaced products;
- (ii) Scavengers, reagents, catalysts, or any other bounded silica whose containers have been opened;
- (iii) Products that are personalized or customized;
- (iv) Refrigerated or temperature-controlled products;
- (v) Products that have been discontinued;
- (vi) Products not directly purchased from SiliCycle

Products sold in distribution by SiliCycle will be subject to the Terms and Conditions Policy of the respective manufacturer.

Prior to any return, an authorization and a return material authorization (RMA) number must be obtained from our Customer Service Department. Shipping instructions will also be provided at this point. The RMA will ensure the safe and proper handling of material; it should therefore be referenced on all shipping labels.

The Buyer has 30 days from the issuance of the RMA to return the goods. Returns made without an authorization number will not be accepted and will be returned to the Buyer.

Returns are subject to a 50% restocking and/or disposal fee.

Shipping Policy

SiliCycle uses a two-day or five-day delivery (or equivalent) depending on weight and availability of product. Standard overnight delivery can also be arranged. Freight charges are prepaid and added to the invoice unless special instructions are requested by the customer. These conditions apply to all North American shipments. International delivery delays will vary according to orders and destination countries.

Delivery

Delivery dates indicated in the contract documents are approximate and based on prompt receipt of all necessary information regarding the product covered by the contract. SiliCycle will use reasonable efforts to meet the indicated delivery dates, but cannot be held responsible for its failure to do so.

In the event of any delivery delay caused by the Buyer, SiliCycle will store and handle all items ordered at Buyer's risk and will invoice Buyer for the unpaid portion of the contract price, plus storage, insurance, and handling charges on or after the date on which the product is ready for delivery. The invoice will be payable in full within 30 days from the invoice date, unless otherwise expressly agreed to in writing by SiliCycle.

SiliCycle will not hold orders unless specifically approved. SiliCycle has the right to make partial shipments and bill for those shipments; the buyer will make payment in accordance with the terms mentioned in this policy.

Shipping and Handling Charges

Shipping charges plus the applicable company handling charges will be prepaid and billed as a separate item on the product invoice. Title to the product and risk of loss shall pass to Buyer upon delivery to a carrier.

Application

All products are sold for laboratory or manufacturing uses. Only professional laboratory staff should handle the chemicals.





As a recognized industry leader in the development, manufacturing and commercialization of innovative silica gel products, and with multi-ton manufacturing capability, SiliCycle® is your partner of choice for all your **metal removal**, **catalysis**, **synthesis**, and **purification** requirements.

SiliaMets®
Metal Scavengers



- No leaching: no API contamination
- High selectivity: total recovery of the API
- Very good metal affinity: efficient for a wide range of metal catalysts
- Solvent compatibility: can be used in any any solvents (pH 2 to 12)
- Fast kinetic even at room temperature
- Easily scalable
- Thermally and mechanically stable
- Ease of use and flexible formats
- Cost efficient: low cost per gram of metal scavenged
- Available in large quantities (**multi-ton scale**)

SiliaCat®
Heterogeneous Catalysts



- Wide range of organic coupling and hydrogenation reactions (**Suzuki, Sonogashira, Heck, and Stille**)
- SiliaCat silica-supported catalysts for cleaner products and cleaner waste streams
- Ideal for batch or flowthrough applications
- Cost efficient and highly stable
- Reusable and leach proof
- Available in sizes ranging from grams to multi-kilograms quantities

SiliaBond® C18
Chromatographic Phase



- Unmatched quality and performance
- Very highly hydrophobic C18 phase
- A homogeneous functionalized layer
- A unique grafting method ensuring reproducible results
- An unprecedented endcapping efficiency
- Incomparable lot-to-lot reproducibility
- The quality of a monofunctional C18
- Available in large quantities (**multi-ton scale**)

SiliaBond®
Functionalized Silica Gels



- No leaching (chemical stability)
- Selective nucleophile and electrophile scavengers
- High resolution chromatographic phases
- **Supported reagents** for organic synthesis
- Thermally stable and microwave compatible
- Available in large quantities (**multi-ton scale**)

SiliaChrom®
HPLC Columns



- Broad pH range (0,8-12,0)
- High surface coverage
- Wide variety of chemistries available
- Excellent column efficiency
- Long column lifetime
- Low bleed

SiliaPlate™
TLC Plates



- Analytical and preparative TLC plates
- Different sizes and choice of backings
- Normal, reversed and specialty phases

SiliaFlash®
Irregular Silica Gels



- High purity irregular Gel
- Tight particle size distribution
- Very low level of fines
- Neutral pH, low metal content, and controlled water level content
- Lot-to-lot reproducibility

SiliaSep™
Flash Cartridges



- High resolution & reproducibility
- Ultra high performance cartridges available (**SiliaSep HP**)
- Compatible with all commercial systems
- Reversed and specialty phases available

SiliaSphere™
Spherical Silica Gels



- Very high purity & tight particle size distribution
- Low metal content
- High mechanical stability
- Wide choice of phases available (normal, reversed & specialty)

SiliaPrep™
Solid Phase Extraction



- Wide choice of SPE cartridge formats, 96-well plates
- Normal, reversed, fluorinated, ion exchange , and mixed-mode phases
- Certified & Specialty phases (scavengers, reagents, etc.)

