



SiliaBond[®]

Organic Scavengers



Distributed by

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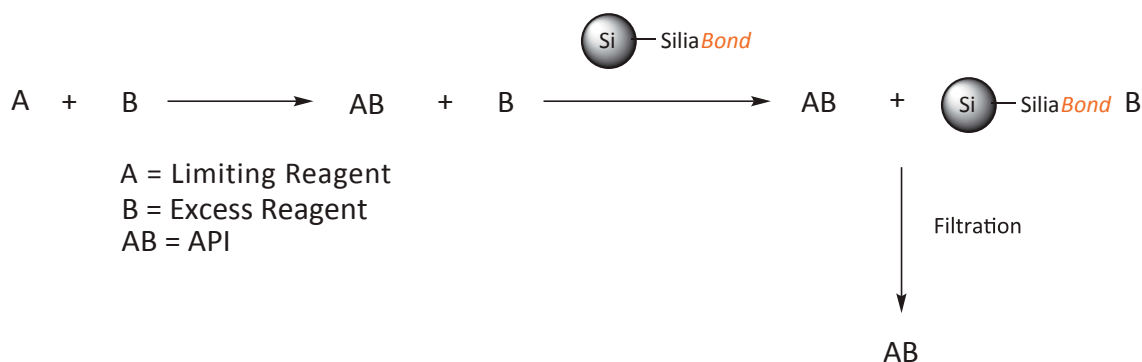
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SiliaBond Organic Scavengers

SiliaBond Organic Scavengers can be Used for the Purification of API's in 2 Different Ways:

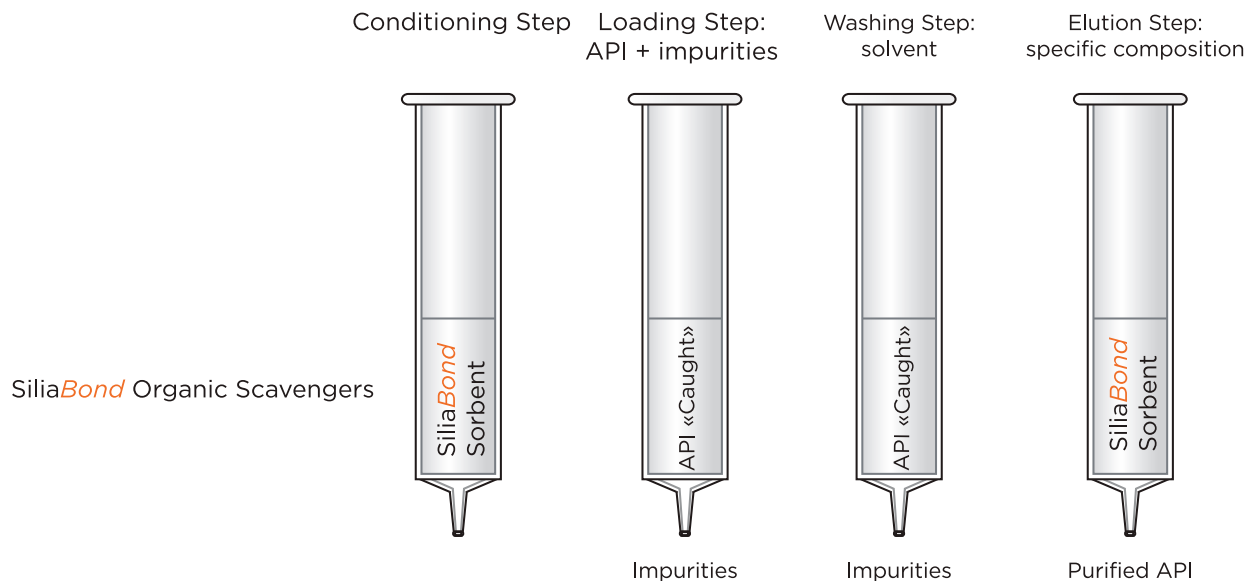
Scavenge Undesired Compounds to Isolate the API

This technique is used to trap the excess of reagent and/or the impurities on the silica matrix. The API is recovered by simple filtration as demonstrated on the following scheme.



Catch and Release of the API

This method is used in an SPE cartridge format where the API is caught on the silica matrix, then filtered to eliminate all other undesired components and finally released back in solution. The catch & release method is shown below.





Scavenging Undesired Compounds: Electrophile Scavengers

Electrophile Scavenger				
Function to be scavenged	Recommended Scavenger	Loading (mmol/g)	Typical conditions	Solvent compatibility
Acid chlorides or sulfonyl chlorides	SiliaBond Amine	1.6	- Add 2 - 4 eq. of SiliaBond SiliaMetS to the reaction mixture	All solvents
	SiliaMetS Diamine	1.4		All solvents
	SiliaMetS Triamine	1.2	- Stir for 1 h at room temperature	All solvents
	SiliaBond DMAP	0.8	- Filter off the scavenger and wash with solvent to attain acid chloride-free solution	Organic solvents
	SiliaBond Piperazine	0.8		All solvents

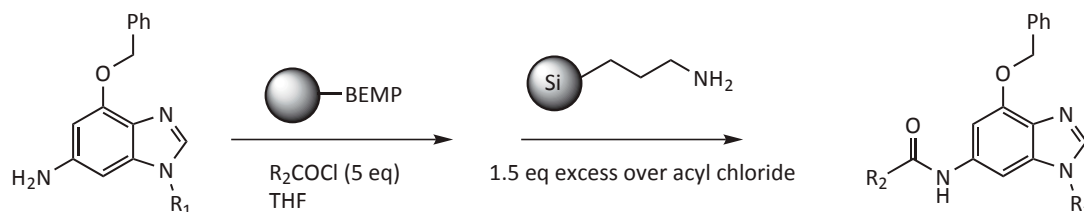
Scavenging Acid Chlorides with SiliaBond Amine

Sample Procedure

Add 1.5 eq of SiliaBond Amine to the reaction mixture, and stir for 1 h at room temperature.

Filter off the scavenger and rinse with solvent to yield acyl chloride free solution.

Related Publication: *J. Catal.*, 195, 2000, 412.



Electrophile Scavenger				
Function to be scavenged	Recommended Scavenger	Loading (mmol/g)	Typical conditions	Solvent compatibility
Aldehydes or carbonyls	SiliaBond Amine	1.6	- Add 2 - 4 eq. of SiliaBond to the reaction mixture	All solvents
	SiliaBond Tosyl Hydrazine	1.5	- Stir for 1 h at room temperature	
			- Filter off the scavenger and wash with solvent to yield aldehyde free solution (<i>ketones and hindered aldehydes add 0.05 eq. of acetic acid</i>)	Aprotic and non carbonyl solvents

Scavenging Undesired Compounds: Electrophile Scavengers (con't)

Electrophile Scavenger				
Function to be scavenged	Recommended SiliaBond scavenger	Loading (mmol/g)	Typical conditions	Solvent compatibility
Isocyanates	SiliaBond Amine	1.6	<ul style="list-style-type: none"> - Add 2 - 4 eq. of SiliaBond to the reaction mixture - Stir for 1 h at room temperature - Filter off the scavenger and wash with solvent to afford isocyanate free solution 	All solvents
	SiliaMetS Diamine	1.4		All solvents
	SiliaMetS Triamine	1.2		All solvents
Anhydrides	SiliaBond Amine	1.6	<ul style="list-style-type: none"> - Add 2 - 4 eq. of SiliaBond to the reaction mixture - Stir for 1 h at room temperature - Filter off the scavenger and wash with solvent to afford anhydride free solution 	All solvents
Chloroformates	SiliaBond Amine	1.6	<ul style="list-style-type: none"> - Add 2 - 4 eq. of SiliaBond to the reaction mixture - Stir for 1 h at room temperature - Filter off the scavenger and wash with solvent to afford chloroformate free solution 	All solvents
	SiliaMetS Diamine	1.4		All solvents
	SiliaMetS Triamine	1.2		All solvents

Scavenging Undesired Compounds: Nucleophile Scavengers

Nucleophile Scavenger				
Function to be scavenged	Recommended SiliaBond scavenger	Loading (mmol/g)	Typical conditions	Solvent compatibility
Acids or acidic phenols	SiliaBond Amine	1.6	<ul style="list-style-type: none"> - Add 2 - 4 eq. of SiliaBond to the reaction mixture - Stir for 1 h at room temperature - Filter off the scavenger and wash with solvent to afford acid free solution 	All solvents
	SiliaMetS Diamine	1.4		All solvents
	SiliaMetS Triamine	1.2		All solvents
	SiliaBond Carbonate	0.7		Organic solvents
	SiliaBond TBD	0.9		All solvents

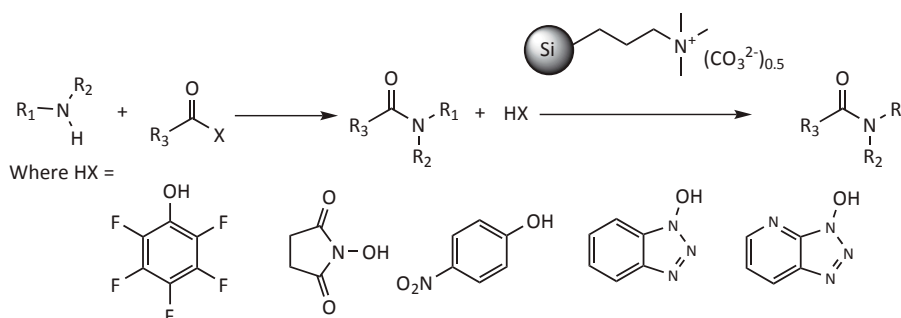
Amine free basing using SiliaBond Carbonate

Trifluoroacetic acid (TFA) is certainly the most commonly used ion-pairing agent for the separation of peptides in reversed-phase chromatography. The role of TFA is to act as a buffer, keeping the charge on the analyte and avoiding precipitation, to impart some hydrophobicity to the amino groups and to neutralize cationic charges. SiliaBond Carbonate is an efficient and convenient solution to this problem. See page 180 of this catalog for more details.



Scavenging phenols and acids with SiliaBond Carbonate

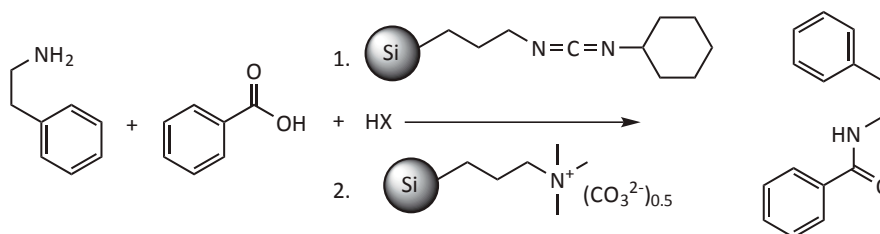
The efficiency of SiliaBond Carbonate as a scavenger of various coupling reagents (HX), including pentafluorophenol, N-hydroxysuccinimide (HOSu or NHS), 4-nitrophenol, 1-hydroxybenzotriazole (HOBt), and 1-hydroxy-7-azabenzotriazole (HOAt) is shown below, as well as a comparison with 2 suppliers of polymer-supported carbonate.



Scavenging Phenols Results

HX	SiliaBond Carbonate		Polymer 1		Polymer 2	
	5 min	60 min	5 min	60 min	5 min	60 min
Pentafluorophenol ¹	2	2	8	5	15	6
N-Hydroxysuccinimide	7	< 5	59	36	60	58
4-Nitrophenol	6	4	11	5	23	12
1-Hydroxybenzotriazole ²	12	4	32	8	74	4
1-Hydroxy-7-azabenzotriazole ²	3	3	28	4	70	8

Initial concentration: 5,000 ppm - 3 eq. of SiliaBond Carbonate. Analyzed by UV. ¹Analyzed by GC-MS, ²in THF



Amide Coupling Results

HX	Yield (%)	Purity (%)
No Catalyst	35.4	95.1
Hydroxysuccinimide ¹	67.2	98.0
1-Hydroxybenzotriazole ²	98.9	97.7
1-Hydroxy-7-azabenzotriazole ²	100	99.2

1.0 eq. of amine, 1.5 eq. acid, 1.7 eq. catalyst (HX), 2.0 eq. SiliaBond Carbodiimide, 7.0 eq. SiliaBond Carbonate. Yield refers to the mass of isolated product. Purity was determined by GC-FID. ¹ in DCM, ² in THF

Related publication

- P. Wipf et al., *Tetrahedron*, **61**, 2005, 11488.
- B. Desai et al., *Tetrahedron*, **62**, 2006, 4651.
- S. Mao et al., *J. Comb. Chem.*, **10**, 2008, 235.
- T. Emmerich et al., *Bioorg. Med. Chem. Lett.*, **20**, 2010, 232.
- D. R. Sauer et al., *Org. Lett.*, **5**, 2003, 4721.
- S. Werner et al., *J. Comb. Chem.*, **9**, 2007, 677.

Scavenging Undesired Compounds: Nucleophile Scavengers (con't)

Nucleophile Scavenger				
Function to be scavenged	Recommended SiliaBond scavenger	Loading (mmol/g)	Typical conditions	Solvent compatibility
Alcohols	SiliaBond Tosyl Chloride	1.0	<ul style="list-style-type: none"> Add 2 - 4 eq of SiliaBond to the reaction mixture Stir for 1 h at room temperature Filter off the scavenger and wash with solvent to remove alcohol from solution 	Anhydrous aprotic solvents and unstable in DMF
Alkoxides	SiliaBond Tosyl Chloride	1.0	<ul style="list-style-type: none"> Add 2 - 4 eq of SiliaBond to the reaction mixture Stir for 1 h at room temperature Filter off the scavenger and wash with solvent to obtain alkoxide-free solution 	Anhydrous aprotic solvents and unstable in DMF Anhydrous aprotic organic solvents
	SiliaBond Isocyanate	1.2		
Amines (primary, secondary or anilines)	SiliaBond Carboxylic Acid	1.4	<ul style="list-style-type: none"> Add 2 - 4 eq of SiliaBond to the reaction mixture Stir for 1 h at room temperature Filter off the scavenger and wash with solvent to remove amine from solution 	All solvents
	SiliaBond Tosic Acid	0.8		All solvents
	SiliaBond Propylsulfonic Acid	1.0		All solvents
	SiliaBond Isocyanate	1.2		Anhydrous aprotic organic solvents
	SiliaBond Tosyl Chloride	1.0		

Scavenging of amine with SiliaBond Isocyanate

Scavenging Amines Results		
Scavenger	Benzylamine	Aniline
SiliaBond Isocyanate	98.7	94.4
Polymer 1	100	98.9
Polymer 2	100	99.2

Conditions: 3 eq. relative to amine, 1 h at room temperature in DCE
% scavenged determined by GC-MS

Scavenging of benzylamines with SiliaBond Isocyanate in different solvents

Scavenging Benzylamine Results			
Scavenger	THF	DCM	ACN
SiliaBond Isocyanate	> 98%	> 98%	95%
Polymer 1	> 98%	> 98%	79%
Polymer 2	> 98%	> 98%	88%

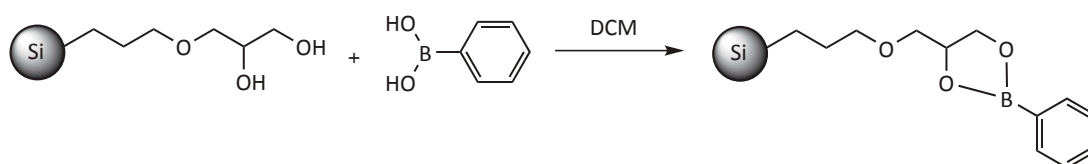
Conditions: 3 eq. relative to amine, 1 h at room temperature
% scavenged determined by GC-MS



Nucleophile Scavenger

Function to be scavenged	Recommended SiliaBond scavenger	Loading (mmol/g)	Typical conditions	Solvent compatibility
Boronic acids	SiliaBond Carbonate	0.7	<ul style="list-style-type: none"> - Add 2-4 eq of SiliaBond to the reaction mixture - Stir for 1 h at room temperature - Filter off the scavenger and wash with solvent to yield boronic acid-free solution 	Organic solvents
	SiliaBond Diol	1.0		All solvents
	SiliaBond TBD	0.9		All solvents

Scavenging boronic acids with SiliaBond Diol



Scavenging Boronic acids Results

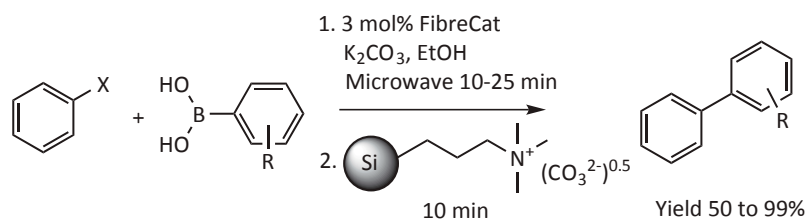
Equivalent	Time	Efficiency
2	1 h	75%
4	1 h	100%

Conditions: 2-4 eq. relative to boronic acid, 1 h at room temperature
% scavenged determined by GC-MS

Scavenging boronic acids with SiliaBond Carbonate

Related publication

Y. Wang and D. R. Sauer, *Org. Lett.*, 6, 2004, 2793.



Scavenging Boronic acids Results

Equivalent	100%	100%	100%	100%
10				

Scavenging Undesired Compounds: Nucleophile Scavengers (*con't*)

Nucleophile Scavenger				
Function to be scavenged	Recommended SiliaBond scavenger	Loading (mmol/g)	Typical conditions	Solvent compatibility
Hydrazines	SiliaBond Tosyl Chloride	1.0	<ul style="list-style-type: none"> - Add 2 - 4 eq. of SiliaBond to the reaction mixture - Stir for 1 h at room temperature - Filter off the scavenger and wash with solvent to remove hydrazine from solution 	Anhydrous aprotic solvents Unstable in DMF
Organometallics	SiliaBond Tosyl Chloride	1.0	<ul style="list-style-type: none"> - Add 2 - 4 eq. of SiliaBond to the reaction mixture - Stir for 1 h at room temperature - Filter off the scavenger and wash with solvent to obtain organometallic-free solution 	Anhydrous aprotic solvents Unstable in DMF
Thiol or thiolates	SiliaBond Isocyanate	1.2	<ul style="list-style-type: none"> - Add 2 - 4 eq. of SiliaBond to the reaction mixture - Stir for 1 h at room temperature - Filter off the scavenger and wash with solvent to yield thiol-free solution 	Anhydrous aprotic organic solvents
	SiliaBond Maleimide (<i>thiol</i>)	0.7		Polar solvents (<i>DMF, MeOH and H₂O</i>)





Catch and Release of the API

Catch and Release the API			
Function to be isolated	Recommended SiliaBond scavenger	Loading (mmol/g)	Typical conditions
Amines	SiliaBond Tosic Acid (SCX)	0.8	- Catch the amine on the SiliaBond
	SiliaBond Propylsulfonic acid (SCX-2)	1.0	- Wash with methanol - Release with a solution of 2 M NH ₃ in methanol
Carboxylic acids	SiliaBond TMA Acetate (SAX-2)	1.0	- Catch the carboxylic acid on the SiliaBond - Wash with methanol - Release with 2% AcOH in MeOH or 1% HCl in ACN

Scavenging 2-Iodobenzoic Acid using SiliaBond TMA Acetate and Carbonate

Dess Martin Periodinane (DMP) is a mild and chemoselective oxidant. It is readily accessible, environmentally benign and has a good shelf-life. Further, the ease of handling, simple reaction work-up, product purification and good yields obtained with DMP make it a valuable reagent in organic synthesis.

2-Iodobenzoic acid is the degradation product from DMP formed during the work-up. Most of it can be removed with a basic work-up, but sometimes, it can be difficult to get rid of all this side product.

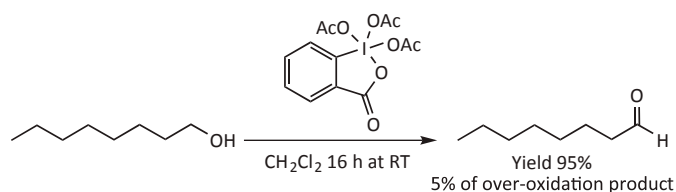
General Procedure

A solution of 1-octanol (1 mmol) in CH₂Cl₂ (6 mL) at room temperature, was added to DMP (1.1 mmol). The reaction mixture was stirred for 16 h, then diluted with 35 mL of MTBE and poured in 20 mL of an aqueous

solution of Na₂S₂O₃ (25%). The mixture was stirred for 10 min. Another portion of 35 mL of MTBE was added for the liquid-liquid extraction. The MTBE phase was then washed with water¹ and a saturated aqueous solution of NaCl (10 mL) and dried on MgSO₄.

Scavenging was done using SiliaBond TMA Acetate or Carbonate, both in bulk (1 g) and SPE cartridge (6 mL/1 g) for comparison purposes. Each sample was washed or eluted with a fresh portion of MTBE (8 mL) and then the 2-iodobenzoic acid was monitored by GC-MS against an internal standard. Over-oxidation product (carboxylic acid) was scavenged with SiliaBond scavengers.

¹The usual NaHCO₃ wash was intentionally omitted in order to get significant amount of residual 2-iodobenzoic acid in the final solution.

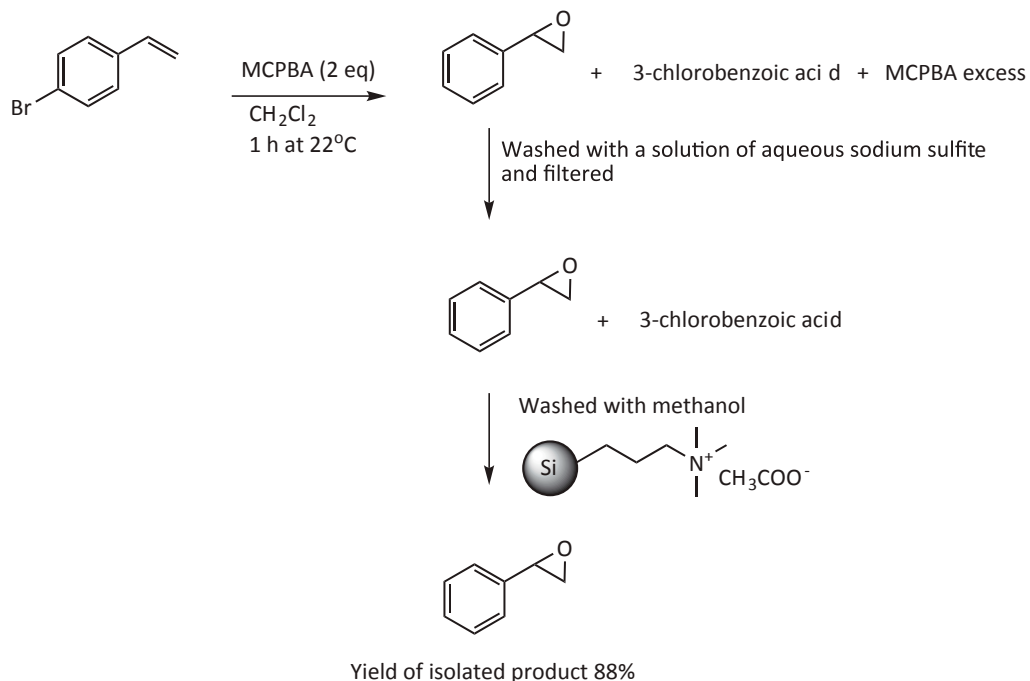


Scavenging 2-Iodobenzoic acid Results (%)

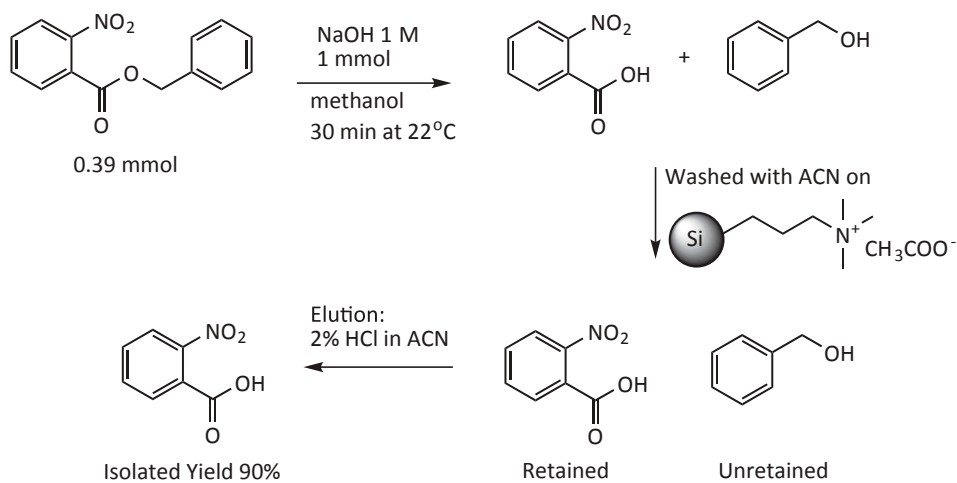
Sorbent	Bulk	SiliaPrep
SiliaBond TMA Acetate	100	100
SiliaBond Carbonate	100	100

Catch and Release of the API (con't)

Ester hydrolysis purification using SiliaBond TMA Acetate



Ester hydrolysis purification using SiliaBond TMA Acetate





SiliaBond Ordering Information

SiliaBond Organic Scavenger Part Numbers		
Scavenger	Part Number	Available Quantity
SiliaBond Amine	R52030B	
SiliaBond Carbonate	R66030B	
SiliaBond Carboxylic Acid	R70030B	
SiliaMetS Diamine	R49030B	5 g
SiliaBond Diol	R35030B	10 g
SiliaBond DMAP	R75530B	25 g
SiliaBond Isocyanate	R50030B	50 g
SiliaBond Maleimide	R71030B	100 g
SiliaBond Piperazine	R60030B	250 g
SiliaBond Propylsulfonic Acid	R51230B	500 g
SiliaBond TBD	R68530B	1 kg
SiliaBond TMA Acetate	R66430B	5 kg
SiliaBond Tosic Acid	R60530B	10 kg
SiliaBond Tosyl Chloride	R44030B	25 kg
SiliaBond Tosyl Hydrazine	R61030B	...
SiliaMetS Triamine	R48030B	Multi-Ton
		Call us for details