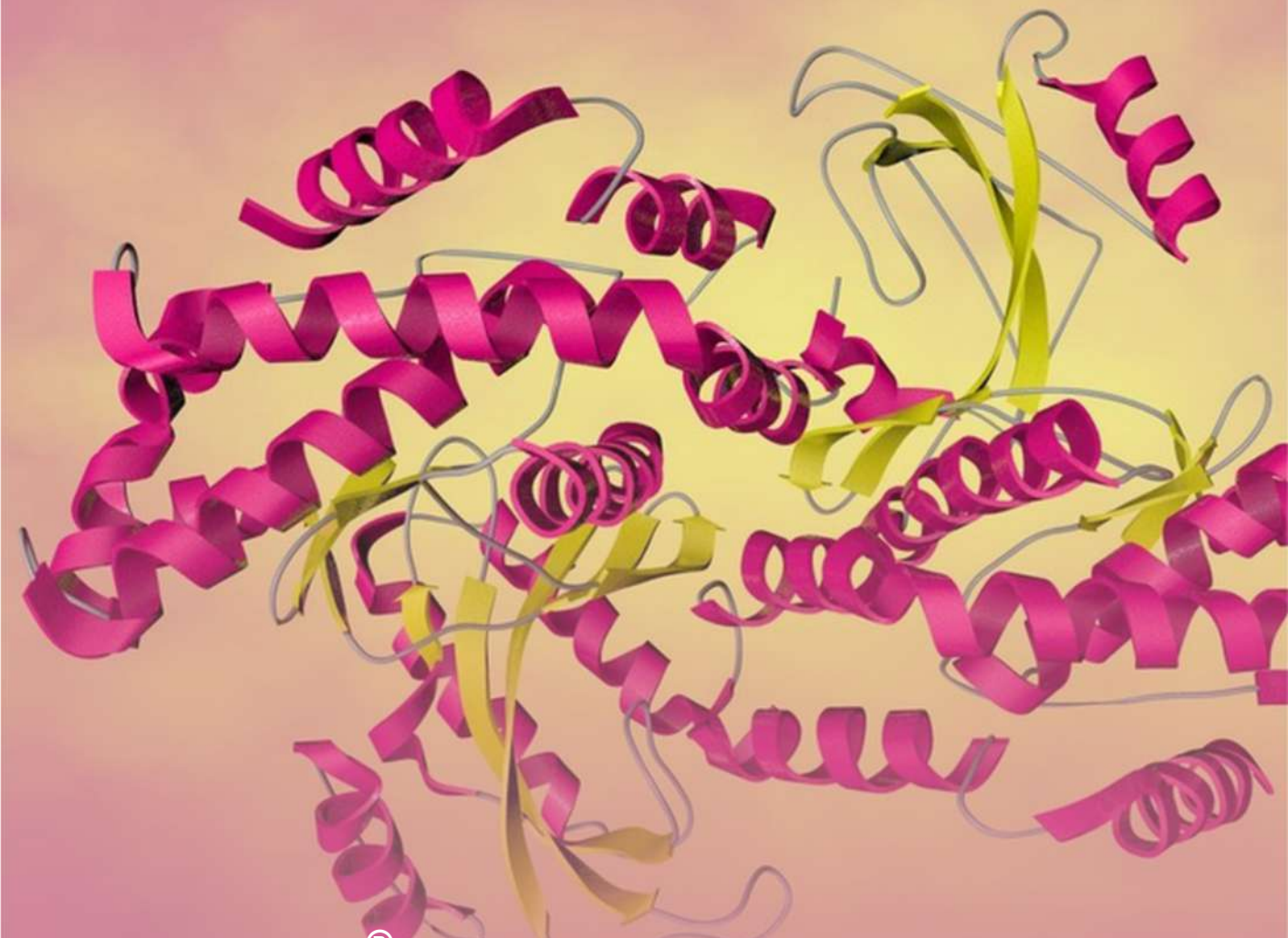




SEPLIFE



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Seplife[®] Enzyme Carriers

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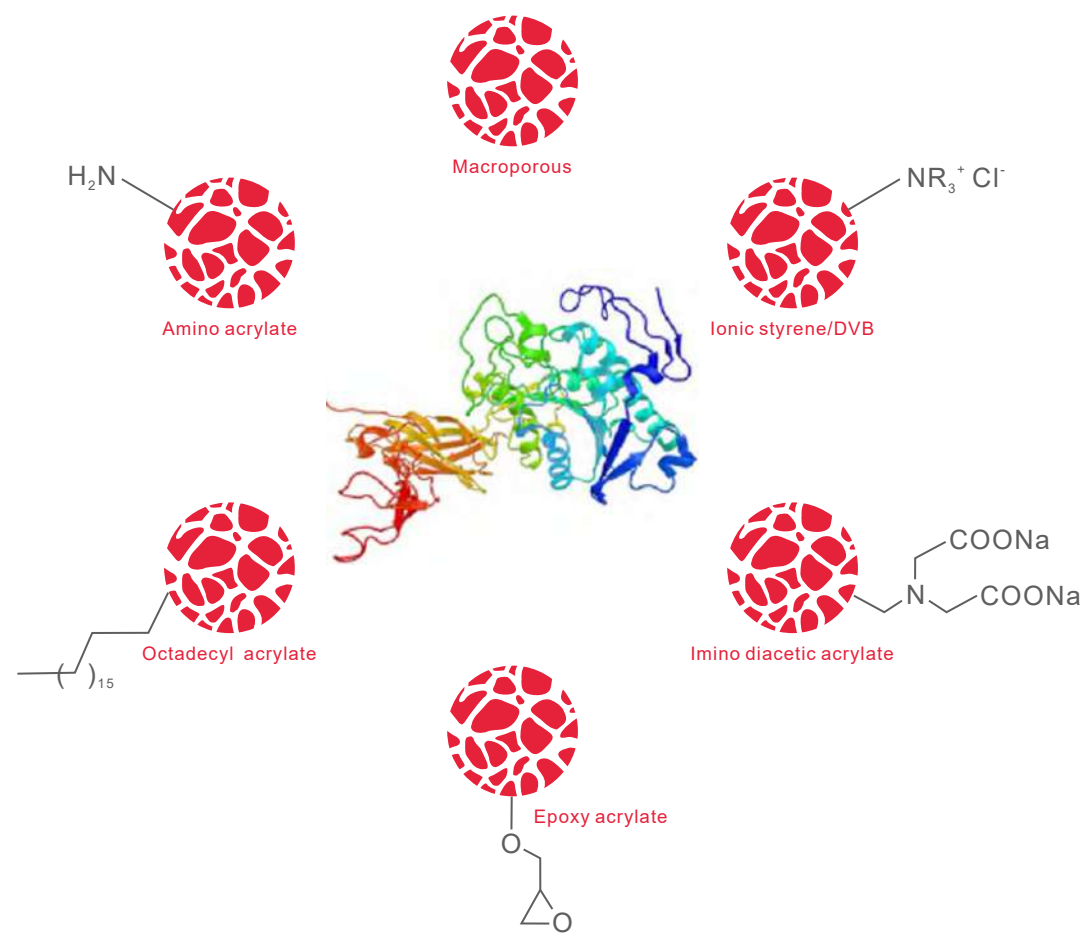
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1. Seplife Enzyme Carrier Portfolio

Seplife EMC range is the largest portfolio of enzyme immobilization resins in the world. With styrenic, methacrylic and polyethylene base matrices with a wide range of physical, chemical and mechanical properties, Sunresin offers the solution for efficient ionic, covalent, affinity or adsoption-based enzyme immobilizations in pharmaceutical, chemical, nutraceutical or food and beverage applications. High cross-linking ensures mechanical stability, and high functional group density allows multipoint covalent binding for minimal enzyme leakage. Immobilization via ionic interaction is achieved with ion exchange resins which are cost-effective, as they can be regenerated after enzyme exhaustion. For affinity-based enzyme immobilizations, the IDA offers high His-tagged enzyme selectivity and stability.

- Large scale manufacturing capabilities
- Customization (particle size, porosity, functional group)
- Short lead times (45-60 days manufacturing time)
- Manufactured in GMP-like conditions
- Compliance with main regulations



2. Epoxy resins

Epoxy-activated resins allow a simple and fast immobilization of enzymes by multipoint covalent binding between the enzyme and resin.

Seplife epoxy resins are porous, robust and hydrophilic (Table 1). All epoxy acrylate resins are designed to form very stable covalent linkages with different protein groups (amino, thiol, phenolic) under very mild experimental conditions of pH and temperature.

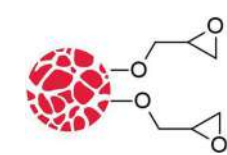


Table 1. Seplife epoxy acrylate resins for covalent enzyme immobilization

Product	Type	Functional group	Immobilization	Pore diameter (Å)	Particle size (micron) ¹	Total moisture (%)
Seplife® EMC7032	Epoxy/butyl acrylate	Epoxy/butyl	Covalent	200-400	150-350	55-65
Seplife® EMC7034	Epoxy/butyl acrylate	Epoxy/butyl	Covalent	500-800	150-600	70-80
Seplife® EMC7025	Epoxy acrylate	Epoxy	Covalent	300-500	150-350	58-68
Seplife® EMC7014	Epoxy acrylate	Epoxy	Covalent	400-600	150-350	58-68
Seplife® EMC7038	Epoxy acrylate	Epoxy	Covalent	400-600	125-350	60-70
Seplife® EMC7040	Epoxy acrylate	Epoxy	Covalent	500-800	125-350	60-70
Seplife® EMC7042M	Epoxy acrylate	Epoxy	Covalent	800-1200	300-700	58-68
Seplife® EMC7048C	Epoxy acrylate	Epoxy	Covalent	400-600	200-500	50-60

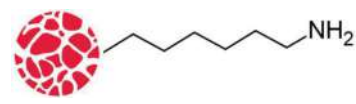
¹ Customization of particle size is available

Epoxy activated resins are available with differing degrees of mechanical stability and hydrophilicity and the final immobilized biocatalysts can be used in either stirred tank or packed bed reactors.

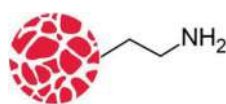
3. Amino resins

Seplife amino acrylate resins allow covalent enzyme immobilization. The resins are functionalized with primary amines, and the covalent immobilization is performed by pre-activation with glutaraldehyde.

Reaction of the aldehyde groups with amino groups of enzymes forms Schiff bases which are very stable in a pH range 3-8 and provide the so called multipoint covalent binding. Seplife amino resins are porous, robust and hydrophilic. All amino acrylate resins, after pre-activation with glutaraldehyde are designed to form very stable covalent linkages with different protein groups (amino, thiol, phenolic) under very mild experimental conditions of pH and temperature. Amino acrylates can be used in either stirred tank or bed reactor.



Amino resins(long spacer C6)



Amino resins (short spacer C2)

Table 3. Seplife amino acrylate resins for covalent enzyme immobilization

Product	Type	Functional group	Immobilization	Pore diameter (Å)	Particle size (micron)	Total moisture (%)
Seplife® EMC7120S	Amino acrylate	Amino (long spacer C6)	Covalent	200-400	100-300	50-60
Seplife® EMC7120M	Amino acrylate	Amino (long spacer C6)	Covalent	200-400	300-700	50-60
Seplife® EMC7225S	Amino acrylate	Amino (short spacer C2)	Covalent	500-700	100-300	60-70
Seplife® EMC7225M	Amino acrylate	Amino (short spacer C2)	Covalent	500-700	300-700	60-70

4. Adsorption immobilization resins

Seplife enzyme carriers also include resins for adsorption. Enzyme immobilization by adsorption is particularly useful for all enzymes that need to be used in oils and organic solvents.

Enzyme immobilization by adsorption is based on the physical adsorption of enzyme protein on the surface of water-insoluble carriers. The method is very gentle and causes little or no conformational change of the enzyme or destruction of its active center. This method is particularly suitable for applications in organic solvents or hydrophobic media such oils. A major advantage of adsorption as a general method of immobilizing enzymes is that usually no additional reagents are required.

Adsorption on hydrophobic resins occurs via interfacial activation of the lipase on the hydrophobic supports at low ionic buffer strength or even water.



Octadecyl resin(C18)



Macroporous resins

Table 4. Seplife resins for enzyme immobilization by adsorption

Product	Type	Functional group	Immobilization	Pore diameter (Å)	Particle size (micron)	Total moisture (%)
EMC7528	Octadecyl acrylate	Octadecyl (C18)	Adsorption	200-400	400-1000	55-65
EMC1040	Acrylate/DVB	None	Adsorption	150-300	300-700	55-65
EMC1020	Styrene/DVB	None	Adsorption	500-1000	300-900	45-55
EMC1120	Polypropylene	None	Adsorption	100-200	300-2300	<5

5. Ionic and affinity immobilization resins

Seplife EMC resins for ionic enzyme immobilization are polystyrenic weak or strong base anion resins having tertiary amine or quaternary amine functionality. Seplife EMC resins for ionic enzyme immobilization have an industrial particle size grade (315-1250 micron) that allows easy scale-up and packing in large columns.

Ionic immobilization is a simple immobilization technique and does not grossly alter the activity of the bound enzyme. In case of enzymes immobilized through ionic interactions, adsorption and desorption of the enzyme depends on the basicity of the ion exchanger. The dynamic equilibrium between the enzyme and the support depends on the isoelectric point of the enzyme, its optimal pH of activity and the ionic strength of the immobilization buffer. The reversibility of binding allows the economic recovery/regeneration of the support after enzyme activity exhaustion. Ionic immobilization of enzymes has been successfully adopted in many industrial food processes.

Enzyme immobilization by affinity is suitable for recombinant enzymes that are manufactured containing a His-Tag. Due to the nature of the His-tag, the enzyme would be more flexible than in other immobilizations and it can be orientated upon immobilization. Among other advantages, the resin can be also regenerated after enzyme activity exhaustion.



Table 5. Seplife resins for ionic and affinity immobilization

Product	Type	Functional group	Immobilization	Pore diameter (Å)	Particle size (micron)	Total moisture (%)
Seplife® EMC7435	Ionic styrene/DVB	Quaternary amine (Cl ⁻)	Ionic	500-700	315-1250	60-70
Seplife® Chelex7350	Iminodiacetic acrylate	Iminodiacetic (Na ⁺) IDA	Affinity	800-1000	100-250	60-70

6. References

1) Basso A., Serban S., “Industrial applications of immobilized enzymes—A review”, Molecular Catalysis, 2019, DOI:10.1016/j.mcat.2019.110607.

2) C. Rosati, O. Piccolo, A. Petri “Study on the Immobilization of a Transaminase Biocatalyst for the Synthesis of Sitagliptin”, Catalysts, 2025, <https://doi.org/10.3390/catal15040326>

3) B. Tagliabue, C. M. Heckmann, R. Villa, S. Grisel, J.-G. Berrin, M. Lafond, D. Ribeaucourt, C. E. Paul “Enantioselective synthesis of (R)-citronellal from geraniol with an immobilised copper alcohol oxidase and ene reductase”, Reaction Chemistry & Engineering, 2025, DOI: 10.1039/d5re00034c

7. Shelf Life and Storage Temperature

Product	Shelf life	Storage temperature (°C)
Epoxy resins	6 months	2-8
Amino resins	3 years	2-20
Octadecyl acrylate	3 years	2-20
Quaternary styrene/DVB	3 years	2-20
Iminodiacetic acrylate	3 years	2-20

8. Stability of epoxy enzyme carriers over temperature and time

Resins functionalised with epoxide groups are temperature sensitive and could hydrolyse during resin storage in certain conditions leading to lower enzyme activity. Generally, the recommended prolonged storage temperature for epoxy functionalised resins is 2-8°C for six months.

Storage temperature has a significant impact on the enzyme activity for all epoxy functionalized resins.

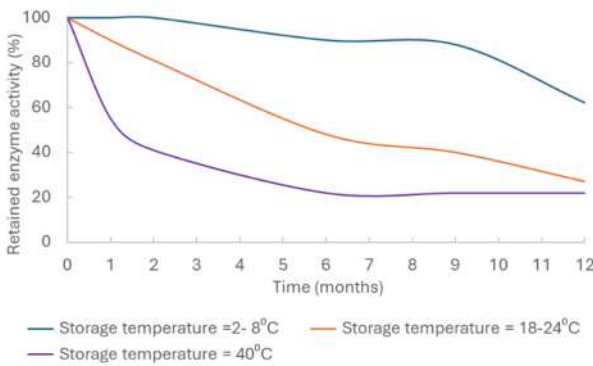
Usually, the enzyme activity drops significantly when resins are stored at 40°C to approx. 20% after 6 months and 50% of the initial activity after 1 month storage.

For RT (18-24°C) storage there is a slow gradual decrease in activity with retained activity of about 50% after 6 months and 20% after 12 months.

The resins stored in the fridge at 8°C showed approx. 90% of the initial activity after 6-month storage and about 60% after 12 months.

Based on results shown below we can predict that generally epoxy resins are stable > 80% for 6 months when stored at 2-8°C. Storage at room temperature is recommended for short periods, one - two months period only, preferably less. Very fast epoxide degradation takes place when stored at higher temperatures such as 40°C. Exposing the product at high temperatures should be avoided.

Based on the above results it is recommended for prolonged storage to keep the resin under refrigerated conditions (2-8°C) whereas shipping can be done at room conditions. After the recommended 6 months storage, the shelf life of the resin could be extended by retesting its performance.



Typical trend of the retained enzyme activity over time when epoxy resin is stored at the specified temperatures.

9. Packaging information

Packaging sizes available:

- 500g • 1kg • 5 kg • 10kg • 25kg

Industrial packaging (25Kg):

- Option 1 (preferred for dry products)
Seplife® enzyme carriers are packed in PE bags as primary package and in blue plastic kegs as secondary package.



- Option 2 (preferred for wet products)
Seplife® enzyme carriers are packed in PE FFS bags and arranged on a pallet very well protected for transportation.
The packaging is Halal and Food Grade compliant.



10. Ordering Information

PRODUCT	Product Code	PACK SIZE
Seplife® EMC7014	PM014S01	500g
	PM014S02	1kg
	PM014S03	5kg
	PM014S04	10kg
	PM014S05	25kg
Seplife® EMC7032	PC013S01	500g
	PC013S02	1kg
	PC013S03	5kg
	PC013S04	10kg
	PC013S05	25kg
Seplife® EMC7120S	PM033S01	500g
	PM033S02	1kg
	PM033S03	5kg
	PM033S04	10kg
	PM033S05	25kg
Seplife® EMC7225S	PM025S01	500g
	PM025S02	1kg
	PM025S03	5kg
	PM025S04	10kg
	PM025S05	25kg
Seplife® EMC7528	PM042I01	500g
	PM042I02	1kg
	PM042I03	5kg
	PM042I04	10kg
	PM042I05	25kg
Seplife® EMC7040	PM018S01	500g
	PM018S02	1kg
	PM018S03	5kg
	PM018S04	10kg
	PM018S05	25kg

PRODUCT	Product Code	PACK SIZE
Seplife® EMC7025	PC013M01	500g
	PC013M02	1kg
	PC013M03	5kg
	PC013M04	10kg
	PC013M05	25kg
Seplife® EMC7120M	PM033M01	500g
	PM033M02	1kg
	PM033M03	5kg
	PM033M04	10kg
	PM033M05	25kg
Seplife® EMC7225M	PM025M01	500g
	PM025M02	1kg
	PM025M03	5kg
	PM025M04	10kg
	PM025M05	25kg
Seplife® Chelex 7350	PM057S01	500g
	PM057S02	1kg
	PM057S03	5kg
	PM057S04	10kg
	PM057S05	25kg
Seplife® EMC1020	PS005M01	500g
	PS005M02	1kg
	PS005M03	5kg
	PS005M04	10kg
	PS005M05	25kg
Seplife® EMC7048C	PM014M01	500g
	PM014M02	1kg
	PM014M03	5kg
	PM014M04	10kg
	PM014M05	25kg

PRODUCT	Product Code	PACK SIZE
Seplife® EMC7435	PS066I01	500g
	PS066I02	1kg
	PS066I03	5kg
	PS066I04	10kg
	PS066I05	25kg
Seplife® EMC7038	PM013S01	500g
	PM013S02	1kg
	PM013S03	5kg
	PM013S04	10kg
	PM013S05	25kg
Seplife® EMC7042M	PM017M01	500g
	PM017M02	1kg
	PM017M03	5kg
	PM017M04	10kg
	PM017M05	25kg
Seplife® EMC1120	PD001H01	500g
	PD001H02	1kg
	PD001H03	5kg
	PD001H04	10kg
	PD001H05	25kg
Seplife® EMC7034	PM126F01	500g
	PM126F02	1kg
	PM126F03	5kg
	PM126F04	10kg
	PM126F05	25kg
Seplife® EMC1040	PC009M01	500g
	PC009M02	1kg
	PC009M03	5kg
	PC009M04	10kg
	PC009M05	25kg