



MACRONET MN-150

Purolite Adsorbent Polymer

For high-efficiency sorption of complex organics from solutions

TECHNICAL DATA

PRODUCT DESCRIPTION

Purolite Macronets are special sorbents, highly and rigidly crosslinked in the swollen state, and thus characterized by very high internal surface areas, approaching those of activated carbons. As a result of their unique manufacturing technology, they will retain their swollen-state porosity, and hence show little or no change in swelling with change of the permeating liquid, unlike the conventional polymeric sorbents. The performance in some specialized applications can be further enhanced by using Macronet types with the increased hydrophilicity obtainable by the presence on the sorbent's internal surface of a minor amount of ion-exchange or other polar functional groups.

Purolite Macronet MN-150 has a pore structure tailored for the efficient sorption of medium to high molecular weight color bodies such as those found in sugar solutions. They are also suitable for treatment of industrial wastes, both liquid and gaseous, which can contain a wide range of molecular species including low molecular weight chlorinated hydrocarbons. The resin is normally supplied in a water-wet form.

A general advantage of this product type is the ease of regeneration. Where the loaded organics contain acid functionality, it is possible to desorb using alkaline brine. In some cases, removal efficiency is improved by use of aqueous alkaline/methanol mixtures. Hot aqueous solution and steam can also prove effective.

TYPICAL PHYSICAL AND CHEMICAL CHARACTERISTICS

Polymer Matrix Structure	Crosslinked Poly(styrene)
Physical Appearance	Brownish-orange spherical beads
Whole Bead Count	>90%
Functional Groups	Tert-Amino
Weak Base Capacity	0.5 eq/l
Shipping Weight (approx)	670-700 g/l, (42-44 lbs/ft ³)
Screen Size Range (U.S.A. Standard)	16-50 Mesh
Particle Size Range	5% max. > 1.2 mm; 1% max. < 0.3 mm
Volatile (moisture) %	51-56
Shrink/Swell Factor, max	±5%
Specific Gravity	1.04 g/ml
Specific Surface Area	900 - 1200 m ² /g
Pore Volume	0.6 - 0.8 ml/g
Temperature Limitations	See Below (*)
PH Range (Stability)	0 - 14

*Operational temperatures are essentially limited by the type of solvent or regenerant used and its vapor pressure/ temperature curve. Temperatures greater than about 120°C, 250°F may, however, result in a softening of the polymer and some impacting of the bed.

TECHNIQUES OF REGENERATION

Various techniques of regeneration are possible. The choice of technique will depend upon a number of factors including the following:

- 1) Type of sorbed materials
- 2) Quantity and concentration of sorbed materials
- 3) Contact time of sorption cycle
- 4) Temperature of operation (sorption and regeneration)
- 5) Cost of regenerant options
- 6) Scale of operation
- 7) Costs of regenerant disposal
- 8) Possibilities for regenerant recovery
- 9) Quality of treated solution
- 10) Predicted life of macronet

REGENERANTS

Regenerants are of four categories:

1) Solvents :

- a) Methanol ; b) Acetone ; c) Isopropanol
- 3-6 bed volumes (removal of phenols and their derivatives usually needs 6 BV)
- Recommended flow rate : 2 -4 bed volumes per hour

2) Acids :

- Hydrochloric acid is generally preferred
- Sulphuric acid could sometimes have economic advantages
- 6 bed volumes at 2 - 4 bed volumes per hour
- Recommended concentration : 2%

3) Sodium Hydroxide :

- 6 bed volumes at 2 - 4 bed volumes per hour
- Recommended concentration : 2%

4) Steam :

- Temperature 95 -120°C (200-250 °F) approximate
- 0.8-1.2 kg per liter of macronet

There are considerable benefits to be gained by operation counter-flow with upstream loading and regeneration down-flow. This technique ensures the water condensed in the regeneration process does not fall back into the regenerated portion of the resin.

REGENERANT RECOVERY

In the case of category 1 above, distillation to recover the solvents for reuse can be economic, both in terms of direct savings of regenerant, and by reduction of waste disposal by waste concentration. In some instances the regenerant concentrate can be recycled in the process to yield some benefits in product recovery.

For categories 1, 2, and 3, a system of progressive regeneration where the second half of spent regenerant is used as the first half in the next regeneration cycle. In this way the waste regenerant is fully saturated. Hence the efficiency of regeneration is improved by reducing regenerant volumes and ensuring that the volume of waste is minimized.

OPERATING PERFORMANCE

The operating capacity of Macronet MN-150 is dependent both on the nature and the concentration of the organics to be adsorbed. Macronet MN-150 has an essentially hydrophobic matrix, hence operating performance can be enhanced by the presence of electrolytes in the aqueous phase. The salting out effect will increase the differential hydrophilicity/ organophilicity between the water and the adsorbent phase.

The presence of electrolytes has an advantage when removing phenols, aromatic solvents including benzene, toluene and hydrocarbons including diesel oils and other petrochemicals. In addition Macronet MN-150 can be used for the removal of chlorinated hydrocarbons, fatty acids, fatty amines and surface active agents, where capacities of over 50 g/l can be obtained dependent upon conditions of operation.

Although the increase in concentration of the organics usually results in an increase of capacity. Macronets are particularly suited to the removal, concentration and recovery of organics from aqueous solutions. They have been found to be quite unique in this respect, and have been applied in the pharmaceutical industry for concentration of specific drugs from dilute solutions.

As a general rule Macronets are superior to other type of adsorbents where the molecular weight of the organic material is relatively low and where at least a portion of the molecule is hydrophobic.

Generally the adsorbed materials are complex bodies which are of moderately high molecular weight and several of these may be present together. Also the quantity adsorbed depends on many factors as discussed under "Regeneration Techniques". Hence it is usually quite difficult

to predict capacity. Tests using specific potentially adsorbable species can be used to characterize the product. Details are available from Purolite.

CHEMICAL STABILITY

1) Macronet products should be kept in sealed containers when not in use. They should not be allowed to dry out. Where this has happened, careful rewetting will be necessary and room to accommodate expansion provided. Complete rewetting can usually be achieved by soaking in organic solvents, such as methanol or acetone which are miscible with water. These can then be removed by rinsing with water, or perhaps more efficiently by steam stripping where a low TOC specification is in place for the aqueous solution to be treated.

2) Macronet MN-150 is insoluble in acids, alkalies, and all common solvents. However, exposure to free chlorine or other strong oxidizing agents over long periods of time will slowly and progressively break down the crosslinking. This will increase the swelling of the resin, decreasing its mechanical strength, and should be avoided.

3) The use of Purolite MN-150 is recommended where there is a requirement to remove partially hydrophobic contaminants from gaseous streams. Where the macronet is being used for the treatment of gases, it may be necessary to condition by replacement of moisture periodically to replace losses by evaporation.

PHYSICAL STABILITY

1) Macronet products are manufactured in spherical form, and provided that they are operated at recommended flow rates in correctly designed equipment, they are physically stable over a wide range of operating conditions. Their mechanical strength is higher than that of most ion exchange resins with mean values in the region of 750-1000 g/bead. Because of their high porosity and surface area, osmotic forces are quickly dissipated, hence resistance to osmotic shock is particularly good. However, they can swell in organic solvents, and room for expansion should be provided. Failure to do this can lead to bead deformation initially and possible vessel rupture if swelling is excessive. Any significant deformation could lead to increased pressure drop.

2) Flow rates are usually limited by operational adsorption rates to around 10 bed volumes per hour. However, if such adsorption are particularly fast and any swelling which occurs as a result is small, then flow rates up to 20 bed volumes per hour are possible without producing noticeable deformations.