

Nitrate Removal

from

Drinking Water

Selective Nitrate Removal

with

Purolite A-520E

Nitrate Removal

Why ?

“Blue Baby Disease”

- Babies under 6 months old --- most prone
- Bacteria in intestines convert nitrate to nitrite
- Nitrite ties up with hemoglobin
- Causes oxygen starvation

What level is safe ?

USA - 45 mg/l as NO_3

W H O - 40 mg/l as NO_3

E C - 25 mg/l as NO_3

Nitrate Removal

Source ?

Groundwater Contamination

- fertilizer run-off
- septic tank

Nitrate Removal

How ?

- Using Standard Type I or Type II Anion Resins
- Using Custom designed PUROLITE A-520E

Why not Type I or Type II ?

For Type I & II:

- Sulfate removed before nitrate
- So Resin capacity for Nitrate is reduced
- Higher Chloride in treated water

Why PUROLITE A-520E ?

For A520E:

- Nitrate removed before sulfate
- So Resin capacity for Nitrate is higher

Why PUROLITE A-520E ?

- Simple brine (NaCl) can be used as a regenerant:
- 150% xs regenerant vs 300% for Type I & II

Why PUROLITE A-520E ?

-No dumping of nitrate at end o f cycle as with Type II

- See graph of SO₄ and NO₃ leakages
for A-520E vs Type I & II

- See graph of lower NO₃ leakage with A-520E

PUROLITE A-520E, CO-FLOW REGENERATION

Fig. 3 OPERATING CAPACITY

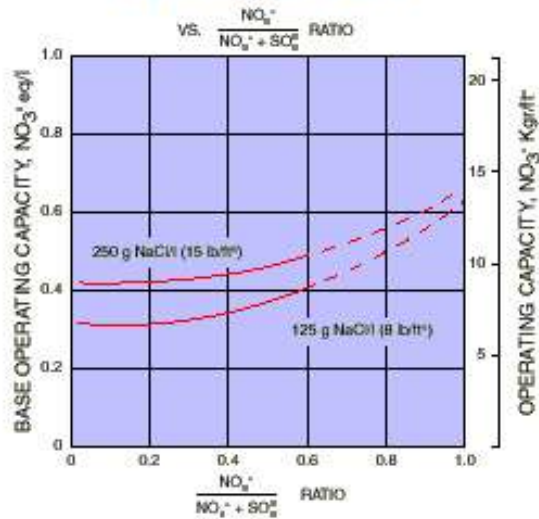
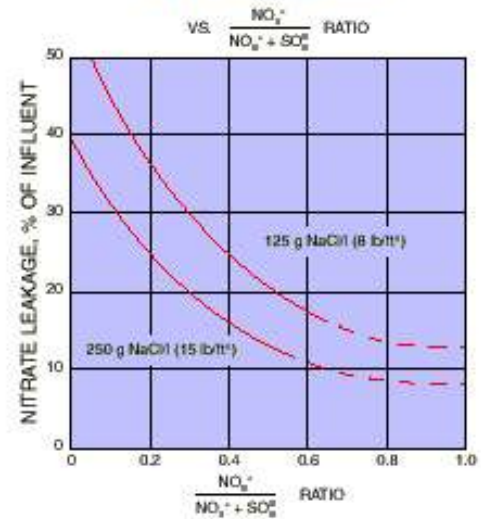


Fig. 4 NITRATE LEAKAGE



PUROLITE A-520E, COUNTER-FLOW REGENERATION

Fig. 5 OPERATING CAPACITY

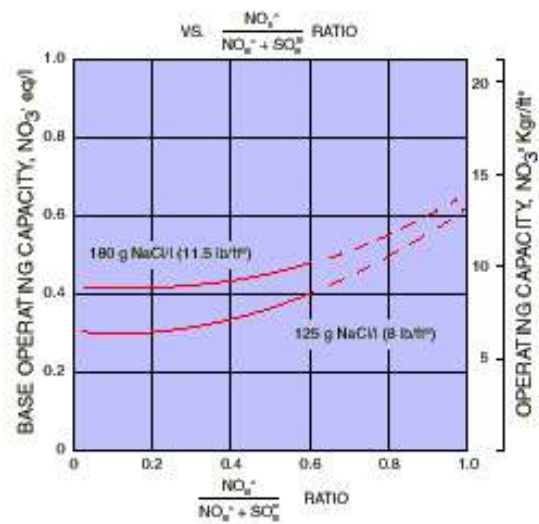
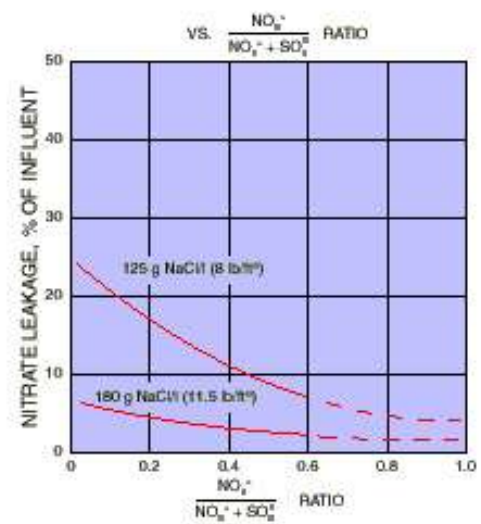


Fig. 6 NITRATE LEAKAGE



Calculation of Throughput for A520E

$$\text{Cyclic Output (liters)} = \frac{V \times \text{OC}}{L - I_n} \times 10^3$$

Where: V = liters of resin

OC = Operating Capacity (eq/l)

L = nitrate load (meq/l)

I_n = nitrate leakage (meq/l)

WATER ANALYSIS

Anions	ppm	meq/l	ppm as CaCO ₃	Cations	ppm	meq/l
Nitrate	93	1.5(L)	76(L _p)	Calcium	90	4.5
Sulphate	98	2.0	100	Magnesium	18	1.5
Chloride	71	2.0	100	Sodium	30	1.3
[HCO ₃ ⁻	122	<u>2.0</u>	100]	Potassium	8	<u>0.2</u>
Total Anions		7.5		Total Cations		7.5
Equivalent Mineral Acidity (EMA)		<u>5.5</u>				

$$\frac{\text{Nitrate}}{\text{Nitrate} + \text{Sulphate}} = \frac{\text{NO}_3^-}{\text{NO}_3^- + \text{SO}_4^{2-}} = \frac{76}{76 + 100} = 0.43$$

*Note: Unless concentration of bicarbonates is well above average it does not affect the performance to a significant extent.

A regeneration level of 125 g NaCl/l has first been chosen, using co-current regeneration.

To calculate the cyclic throughput from the equations given above:

From Fig. 3, Base Capacity at 0.43 for $\frac{\text{NO}_3^-}{\text{NO}_3^- + \text{SO}_4^{2-}} = 0.36$ eq/l

From Fig. 4, Leakage at $\frac{0.43 \text{ NO}_3^-}{\text{NO}_3^- + \text{SO}_4^{2-}} = 23\%$

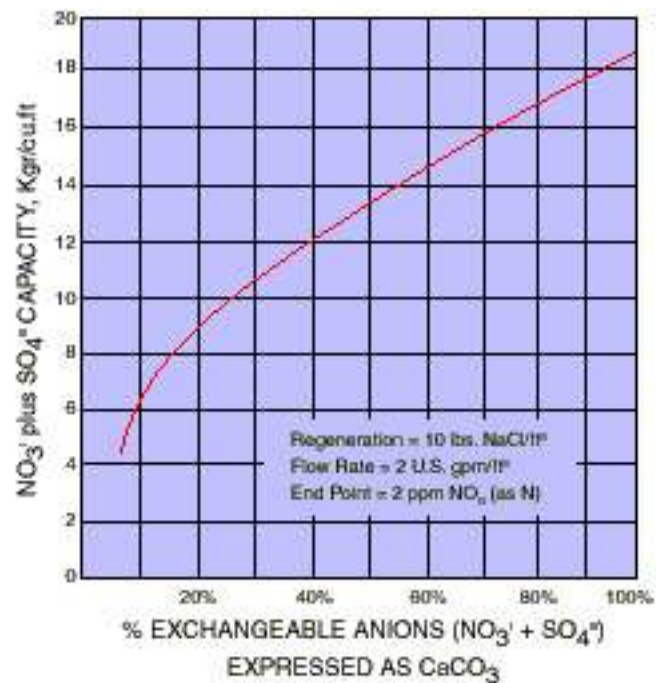
Hence for each litre of resin, throughput: $= (0.36/1.15) \times 10^6$ liters
 $= 313$ liters

And for each cubic foot of resin, $= [7.9/(0.058 \times 57.7)] \times 10^6$
 $= 2360$ U.S. gal.

A-300 E

NITRATE REMOVAL

CAPACITY FOR NITRATE (NO_3^-)
PLUS SULFATE (SO_4^{2-}) REMOVAL



A-520E - Sizing – Small Units

SERVICE: One (1) to four (4) gpm per cubic foot (8 to 32 BV/H)

BACKWASH FLOW RATES (10 to 15 minutes)

TANK DIA. IN INCHES (mm)	8 (200)	9 (225)	10 (250)	12 (300)
Flow at 50°F, gpm (LPM)	0.53 (2)	0.66 (2.5)	0.83 (3.1)	1.19 (4.5)
Flow at 70°F, gpm (LPM)	0.74 (2.8)	0.92 (3.5)	1.16 (4.4)	1.67 (6.3)

Regeneration

REGENERATION:

8 LBS Salt / Cu. Ft. Resin (128 gm /L)
8% Concentration approx.
30 minutes or more

SLOW RINSE: 8 to 10 gallons per cubic foot (1 to 1.25 BV)

FAST RINSE: 20 to 30 gallons per cubic foot (2.5 to 4 BV)
or when outlet chloride < 10% of inlet chloride

Treatment Rate

Nitrogen (N)	Nitrate (NO3)	Nitrate as CaCO3	Gallons /Cu.Ft.	BVs
10	44	36	3589	479
20	89	71	1794	239
30	133	107	1196	159
40	180	140	893	119
50	225	175	746	99

Nitrate Removal

with

A-520E

END