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AMMONIUM EXCHANGE CAPACITY OF ZELBRITE

- Zeolites are alumino-silicate minerals which obtain their cation exchange capacity from the charge imbalance arising from substitution of aluminium for silicon at the time of formation of the mineral - the higher the quantity of aluminium, the greater the exchange capacity of the zeolite.
- The exchange capacity of a 'zeolitic rock' (in contrast to the zeolite itself) is also determined by the percentage of zeolite in the rock.
- Cations are attracted to the framework of the zeolite to balance the charge, but are not actually part of the mineral structure, and can be replaced by other cations without damaging that structure. Access for exchange is through channels within the zeolite (and the zeolitic rock).
- Exchange is stoichiometric - i.e. for one unit of charge taken up by the zeolite, one unit of charge leaves the zeolite [e.g. two singly charged cations (such as ammonium) are required to replace on divalent cation (such as calcium)].
- The exchange capacity of Zelbrite, as marketed, is 119 meq/100 gm of product. Because ammonium contains 14 mg of nitrogen per meq, this means that the maximum ammonium exchange capacity of Zelbrite (under favourable conditions) is 14 x 119 / 100 = 16.66 (say 17) mg N / gm.

- Zeolites are 'selective' towards specific cations largely due to the charge/diameter ratio of the cation [i.e. cations will tend to exchange into the zeolite if they have a high charge/diameter ratio], but with modification to the preferred order if (due to size or shape) cations have difficulty passing through the channels into the zeolite.
- Without selectivity the proportion of a given exchangeable cation in a zeolite, ***at equilibrium,*** would be the same as it's proportion (on a charge basis) in an adjacent solution [i.e. 25/75 in solution would result in 25/75 in the zeolite].
- Due to selectivity the proportion of cations in a zeolite, ***at equilibrium,*** may be markedly different to the proportion in the adjacent solution [and it is *important to remember that* ***proportions*** *in the zeolite are determined by* ***proportions*** *in the adjacent solution, not by concentration as such*].
- Because the zeolite in Zelbrite is selective towards ammonium, it will take up ammonium even when the proportion of ammonium in the adjacent solution is low.
- Selectivity also means that certain cations will compete more strongly with ammonium (for sites on the zeolite) than others. Of those commonly found in water supplies, sodium is generally the most significant [although potassium will compete even more strongly if it is present.
- The diagram at the top of the next page illustrates the effect of sodium on the ammonium capacity of Zelbrite for a system in which the only cations are ammonium and sodium. It can be seen, for example, that for a solution containing (at equilibrium) 1 mg amm.N/L and 10 mg Na/L (the 'middle' curve), the capacity of the Zelbrite is reduced from nearly 17 mg N/gm to about 7.5 mg N/gm.