

Soil amendments contain all the *principal nutrients (N, P and K) and often organic matter* in different proportions but none by themselves will provide a completely balanced fertiliser and they often require to be supplemented from other sources. Table 1 provides a comparison of typical nutrients as well as the content of potentially toxic elements (PTEs) between sewage sludge (literature values) and that of alum sludge taken at 3 time points from the Stornoway WTW. This data indicates that nutrient content (in terms of N,P,K content) from this alum sludge is substantially lower than that of typical sewage sludge. To provide a similar amount of amended nutrients would require increased loadings of alum sludge (> *ca.* 50 times for P) with the potentially detrimental increase in soil aluminium content and the PTEs.

Table 1: Comparison of nutrient and PTE values for sewage sludge and alum sludge from Stornoway WTW.

| Nutrient | Sewage sludge | Stornoway - Treatment Works Water Cake |
|---------------------------------|--------------------------|---|
| Total N (% TS) | 2.4-3.5 ^{b,d} | 0.366 – 1.516 |
| Total P (% TS) | 1.3-1.6 ^{b,d} | <0.024 – 0.026 |
| K (% TS) | 0.2 ^b | 0.011 -0.071 |
| Potential Toxic Elements | | |
| Al | nd. | 129000-138000 |
| As (mg/kg) | 2.5-12.5 ^{c,e} | <7.0 |
| Cd (mg/kg) | 1.0-4.1 ^{a,e} | <0.5 |
| Cu (mg/kg) | 190-641 ^{a,e} | 10.1-73.0 |
| Cr (mg/kg) | 28.5-160 ^{a,e} | <3.0-15.6 |
| Hg (mg/kg) | 0.6-5.1 ^{a,e} | <0.5 |
| Mn (mg/kg) | 389 ^c | 454.8 |
| Mo (mg/kg) | 3.6 ^c | <1.0 |
| Ni (mg/kg) | 15.4-58.5 ^{a,e} | 3.6-50.1 |
| Pb (mg/kg) | 21.7-222 ^{a,e} | <10.0-13.6 |
| Se (mg/kg) | 1.6 ^e | 2.27 |
| Zn (mg/kg) | 340-3641 ^{a,e} | 24.0-46.7 |

^aSmith, 2001, ^bWRc (undated), ^cSEDE Arthur Anderson, 2001 (from very limited data), ^dCecchi et al. (1996), ^eThornton et al. (2001).

It must be noted that the potential risks highlighted in the previous report still apply:

Adding alum sludge to soil is likely to induce P deficiency in plants, because of the high sorption capacity of freshly precipitated aluminium hydroxide to adsorb P. This in conjunction with its low P content suggests very limited value of the alum sludge in terms of P additions, either on its own or in conjunction with sewage sludge.

If alum sludge is added to acid soils it may also raise soil pH, as the pH of the sludge has been measured at 6.9 (Stornoway WTW sludge measurements), (the pH of minimum solubility of aluminium hydroxide is between 6.5 and 7.0). This may increase the risk of leaching aluminium and SO₄ to streams and subsequent acidification.

Normally the reuse of such materials to land requires evidence of ‘agricultural or ecological improvement’. Although some beneficial addition of N, P and K would occur, it is lower than many other soil amendments. Potentially, it could also be added in combination with other sludge (e.g. also containing organic matter) providing the required balance of nutrients. However, currently the benefits of adding alum sludge does not appear to be proven based on the chemical characteristics of sludge produced from Stornoway WTW allied with its potential detrimental effects of increased loadings.

References

Cecchi F., Pavan P. and Mata-Alvarez J. (1996). Anaerobic co-digestion of sewage sludge: application to the macroalgae from the Venice lagoon. *Resources Conservation and Recycling*, 17: 57-66.

SEDE/Arthur Anderson. (2001). Disposal and recycling of sewage sludge (Annex). European Commission DG Environment.

Smith S.R. (2001). The scientific basis to recycling sewage sludge in agriculture. In: *Recycling and Reuse of Sewage Sludge* (eds: Dhir, R K, Limbachiya, M C and McCarthy, M J). Thomas Telford Publishing, London, 2001.

Thornton I., Butler D., Docx P., Hession M., Makropoulos C., McMullen M., Nieuwenhuijsen M., Pitman A., Rautiu R., Sawyer R., Smith S., White D., Wilderer P., Paris S., Marani D., Braguglia C. and Palerm J. (2001). Pollutants in urban waste water and sewage sludge. Report prepared by ICON, IC Consultants Ltd, UK for the European Commission.

WRc (undated). The agricultural value of sewage sludge. A Farmers' Guide.