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SORPTION – DISTRIBUTION OF PHARMACEUTICALS BETWEEN WATER AND SLUDGE AND REMOVAL WITH CARBON (PAC)

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EXECUTIVE SUMMARY

In order to estimate the removal of pharmaceuticals by sorption to sludge in wastewater treatment plants and removal by sorption to powder activated carbon (PAC) the distribution coefficients were obtained by determination of sorption isotherms. Sorption isotherms were obtained for primary sludge, secondary sludge and PAC under conditions were biological removal could be excluded. The aim of the present study was to estimate the amount of PAC needed in order to reach sufficient removal of pharmaceuticals from wastewater.

The method used for determine sorption isotherms are described elsewhere (Hörsing et al., 2011). Shortly, borosilicate bottles were prepared with a phosphor buffer mineral media to which either sludge or PAC was added. After 12 h rehydration nominal concentrations of a mixture of pharmaceuticals in methanol was added, giving the final concentrations 0.08, 0.4, 2 and 10 µg L^{-1}. The bottles were left on stir in dark. After 12 h samples were withdrawn and prepared for analyses employing solid phase extraction using OASIS HLB. The analyses were performed using LC-MS/MS, further described in Grabic et al., (submitted).

Based on pharmaceutical distribution coefficients sorption could be determines and thereby estimation of the amount of PAC needed for removal of 67 pharmaceuticals. For 20 of the pharmaceuticals investigated the sorption to PAC was so strong that the concentrations in the water phase were below LOQ for two or three of the nominal concentrations added. For those pharmaceuticals sorption isotherms could not be obtained. For the estimations distribution coefficients obtained for the highest concentration 10 µg L^{-1} was used. When isotherms could be obtained the best fitted of linear, Freundlich and Langmuir was used for further estimations. In Fig. 1 are the needs of PAC presented for the pharmaceuticals which sorb less than 20% to primary and secondary sludge. Of the 67 pharmaceuticals included 29 could be removed with PAC to >90% by use of 0.05 g m^{-3} and 62 could be removed >90% by use of 10 g m^{-3}.

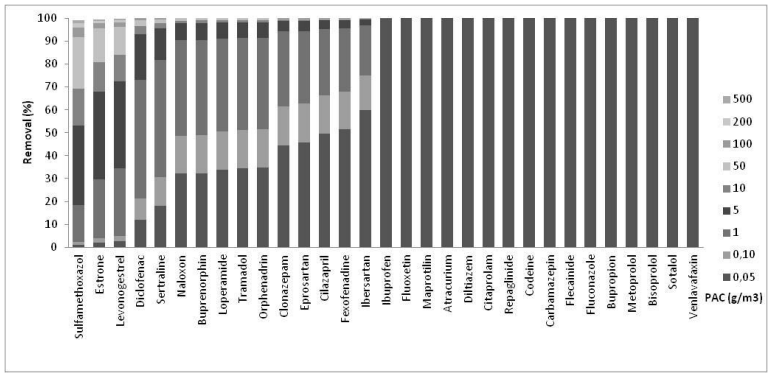

Figure 1. PAC for removal of pharmaceuticals which were found to sorb less than 20% to sludge.