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Entitled

*ASSESSMENT OF CONVENTIONAL WASTEWATER TREATMENT PLANTS IN REMOVING  
PHARMACEUTICAL COMPOUNDS: A CASE STUDY OF AL AIN CITY, UAE*

by

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Abstract

This thesis is concerned with the assessment of conventional wastewater treatment plants (WWTPs) in removing pharmaceutical compounds (PCs). PCs have classes like analgesics, antibiotics, antiseptics, hormones, cosmetic products, personal care products. They are used extensively by humans and they don't have actual guidelines describing their concentration in domestic wastewater discharge. Thus, they may still be present in treated sewage effluent (TSE) or sludge and could consequently pose adverse environmental effect. Limited work has been done to assess the removal of PCs at WWTPs in arid and semi-arid countries including the United Arab Emirates (UAE). As such, this study aimed at investigating the levels of selected PCs in domestic wastewater in Al Ain city before and after treatment. An analytical protocol was developed for identification, quantification, and analysis of 15 PCs using a liquid chromatography tandem mass spectrometry (LC-MS/MS) system. Four batches of used water and sludge samples were collected from different locations at Al Saad WWTP in Al Ain, UAE. Aliquots of each sample were enriched by solid phase extraction (SPE). Results show that phenylephrine, dapson, noscapine, propyl gallate, genistein, and ketoconazole were present in the raw wastewater at low levels ( $<0.1 \mu\text{g/L}$ ), while acetaminophen and caffeine were present at high levels ( $>10 \mu\text{g/L}$ ). The overall removal efficiency of the tested PCs from the water stream in Al Saad WWTP exceeded 99% for cotinine, acetaminophen, caffeine, naproxen, and ibuprofen, but significantly drops ( $<50\%$ ) for phenylephrine, amoxicillin, dapson, noscapine, spiramycin, noscapine, genistein and ketoconazole. Analysis of the results indicate that, for highly removed PCs, the main mechanism of removal is possibly aerobic biodegradation. However, for tyramine, dapson, 9-aminoacridine, noscapine, propyl gallate, and ketoconazole sorption onto the mixed liquor suspended solids (MLSS) first occurs in the aeration tank of the activated sludge system followed by removal by anaerobic digestion.

**Keywords:** Wastewater, pharmaceutical compounds, sludge, Al Saad WWTP, LC-MS/MS, SPE, internal standard, mass balance, Al Ain, UAE.