

# AMTREAT®

## high strength ammonia treatment process

The AMTREAT® process is a purpose designed high rate activated sludge process that can be specifically used for treating high strength ammonia wastewaters. With tightening ammonia and total nitrogen wastewater discharge consents, and higher levels of sludge treatment, returning sludge liquors to the main wastewater treatment works (WwTW) can often cause consent failures. Upgrading existing WwTW can be potentially expensive and problematic. Installation of an AMTREAT® process, dedicated to the treatment of sludge liquors, can provide a cost-effective solution that reduces ammonia and total nitrogen to levels that when returned to the main WwTW will not have a detrimental effect on the WwTW process or final discharge consent.



Cliff Quay AMTREAT® Sludge Liquor Treatment Plant

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### AMTREAT® Process

At the core of the Process is the purpose-designed AMTREAT® reactor which is fully mixed and contains suspended aerobic cultures of predominantly nitrifying bacteria. By careful control of the key design parameters of temperature, the ratio of carbonaceous material to ammonia and alkalinity, the conditions within the reactor encourage the proliferation of nitrifying bacteria so that they become and remain the dominant species. It is this population of nitrifying bacteria that convert ammonia, by complete oxidation, to nitrate. To ensure that nitrification occurs in its entirety it is often necessary to provide a supplemental source of alkalinity. It may also be necessary to use a heat exchange system to raise the temperature of the feed liquors to the required operating temperature.

Denitrification can be achieved by the addition of pre-and/or post-anoxic tanks. Depending on the liquor source, it may be necessary to provide a supplemental carbon source to ensure full denitrification is obtained.

By controlling these key parameters, the process of nitrification is made reliable, predictable and robust.

Operating the reactor within a specific temperature range ensures high rates of nitrification are maintained. Typical loading rates of 1.2 kg NH<sub>4</sub>/m<sup>3</sup>/d can be achieved.

### Cliff Quay Sludge Liquor Treatment Plant

Cliff Quay AMTREAT® Sludge Liquor Treatment Plant (SLTP) was the first full scale AMTREAT® plant to be installed in the UK. ACWA Services Ltd, was awarded a turnkey contract, including civils, from Anglian Water Services in 1998. Construction and commissioning were completed in 1999.

The AMTREAT Plant was designed to treat the centrate liquors from a sludge treatment plant before discharge to the head of the WwTW. Prior to installation of the AMTREAT® process, plant liquors were returned to the WwTW without treatment, resulting in regular failures of the WwTW final discharge consent. The aim of the SLTP was **to reduce the concentration of ammonia to a level that would not impact on the final discharge consent of the WwTW.**

The AMTREAT® SLTP installed consisted of liquor collection sump, balance tank and mixer, shell and tube heat exchange system, AMTREAT reactor with fine bubble diffused air system and final settlement tank. Return activated sludge was returned directly to the AMTREAT reactor, with surplus activated sludge transferred to storage tanks. Supplemental alkalinity was supplied in the form of sodium hydroxide. The plant has now been running successfully for over 6 years.

Fig.1 below shows Influent Characteristics & Treated Effluent Quality

Parameter	Units	Influent Characteristics		Treated Effluent Quality			
		Average	Maximum	Required	Actual		
					Average	95%ile	% Removal
Flow	m <sup>3</sup> /day	300	450				
BOD	mg/l	800	1000	500 (95%ile)	175	250	76
COD	mg/l	1800	2000		400	500	81
Suspended Solids	mg/l	750	750	500 (95%ile)	100	150	80
Ammoniacal Nitrogen	mg/l	1200	1400	50 (absolute)	5	15	>98
Alkalinity	mg/l (as CaCO <sub>3</sub> )	1200 (min)	4800				
Temperature	°C	15	18	25			

**Ashford Sludge Liquor Treatment Plant**

ACWA Services Ltd have been awarded a design contract by Black & Veatch Ltd for a twin stream AMTREAT® Sludge Liquor Treatment Plant for Ashford Sludge Treatment Centre (STC) as part of the Southern Water AMP4 programme. A full contract award for construction is expected by September 2007 with commissioning of the proposed plant by November 2008.

Southern Water is upgrading Ashford WwTW and STC to ensure compliance with its AMP4 requirements. Although the WwTW is also being upgraded it was deemed more cost effective to install a dedicated sludge liquor treatment plant to treat liquors produced from the sludge thickening, dewatering and drying processes. Table 2 details the influent characteristics and required treated effluent quality.

The SLTP is a twin stream AMTREAT® process operating at 50% per stream. In terms of hydraulic throughput each stream is able to take 100% flow, allowing flexibility for maintenance. The plant will consist of balance tank with mixing, anoxic tanks, AMTREAT reactors with fine bubble diffused air systems, stilling tubes, MLSS recycle and final settlement tanks with RAS return and SAS wastage. (Fig.2 below)

The MLSS recycle and RAS will be returned to the anoxic tanks. SAS will be transferred to a storage facility on the main works. Dedicated sodium hydroxide storage and dosing system for the SLTP will provide the required supplemental alkalinity necessary for the nitrification process. As the temperature of the combined liquors is within the optimum range it was considered unnecessary to install a heat exchange system.

The provision of cross connecting pipework through the main process stream allows flexibility for operation and maintenance.

The advantages of such a high-rate ammonia treatment process are that the technology and equipment employed is familiar, easy to operate and control. Due to the significantly higher ammonia loading rates achieved within an AMTREAT® process a smaller footprint compared to conventional activated sludge processes is possible. Full nitrification of effluent streams with ammonia concentrations of 3000 mg/l and typical ammoniacal nitrogen removal rates in excess of 97% is achievable.

Anoxic tanks can be installed pre-and/or post AMTREAT reactor for denitrification if required, although the addition of a supplemental carbon source may be necessary. Typical BOD and COD removal rates are in excess of 75% ensuring the temperature of the influent liquors is maintained above 20 degs C and preferably at a constant 25 degs C, providing optimum condition for nitrification and removes the issues associated with seasonal dependency often encountered with conventional sludge plants. Although this article has focused on the applicability of the AMTREAT® process for the treatment of sludge liquors, it is also suitable for treating high strength ammonia industrial wastewaters.■

**Note:** ACWA Water Services would like to thank Anglian Water Services, Black & Veatch and Southern Water for supporting the publication of the above article.

Parameter	Units	Influent Characteristic		Treated Effluent Quality
		Average	Maximum	
Flow	m <sup>3</sup> /day	1200	2100	
BOD	mg/l	650	550	200
Suspended Solids	mg/l	1750	1750	200
Ammoniacal Nitrogen	mg/l	850	900	50
Temperature	°C	20 - 30	28 - 33	