PNAOSA, 8) DNBSA, 9) ANSDSA, 10) PNTSA, 11) PAABSA, 12) DNSDSA
and 13) BASDSA.

Fig. 3.3 Schematic diagram of an electrospray ionization process.

Fig. 3.4 TIC chromatogram of benzene and stilbenesulfonic acids.

Fig. 3.5 LC-ESI-MS spectra of BASDA with assignment of fragments.

Fig. 3.6 CID spectra compounds (a) PPDSAA, (b) AASA.

Fig.3.7. Fragmentation pattern and proposed fragment ion structures of PPDSAA.

Fig.3.8 Fragmentation pattern and proposed fragment ion structures of AASA.

Fig. 3.9 Validation parameters.

Fig. 3.10 HPLC Chromatograms of industrial effluents. A) PPDSA, B) AASA
and C) PNTSA.

Fig. 3.11 HPLC Chromatograms of industrial effluents. D) DASDSA, E) ANSDSA and F) DNSDSA.

Fig. 4.1 Block diagram of the photo-reactor fabricated and used in the present investigation.

Fig. 4.2 HPLC chromatograms of 1) MPDSA, 2) AASA, 3) PNTSA and 4) DNBSA, a) before irradiation and b) after 48 h of irradiation by UV-light.

Fig.4.3 Time vs concentration profiles of A) MPDSA, B) AASA C) PNTSA and D) DNBSA by direct photolysis at pH 2.5, 5.0, & 8.0.
Fig. 4.4 Effect of concentration of TiO₂ on the removal of TOC of 0.1mM AASA (irradiation time 4 h).

Fig. 4.5 Effect of pH on the removal of TOC by TiO₂/UV (Concentration of TiO₂ - 2 g/L, sulfonic acid - 0.1 mM and irradiation time 6 h).

Fig. 4.6 Effect of initial concentration on the disappearance of test compounds by TiO₂/UV (Concentration of TiO₂ 2 g/L, pH-3.0 and irradiation time 2 h).

Fig. 4.7 Effect of concentration of Fe²⁺ on the removal of TOC by Fe²⁺/H₂O₂/UV.

Fig. 4.8 Effect of pH on the removal of TOC by Fe²⁺/H₂O₂/UV.

Fig. 4.9 Effect of H₂O₂ concentration on the removal of TOC in Fe²⁺/H₂O₂/UV.

Fig. 4.10 Effect of initial concentration of A) MPDSA, B) AASA, C) PNTSA and D) DNBSA on the disappearance of the test compound by Fe²⁺/H₂O₂/UV.

Fig. 4.11 Photo degradation pathway of benzene sulphonates.

Fig. 4.12 Disappearance of the test compounds and removal of TOC at the optimized conditions by TiO₂/UV. A) MPDSA, B) AASA, C) PNTSA and D) DNBSDA.

Fig. 4.13 Disappearance of the test compounds and removal of TOC at the optimized conditions by Fe²⁺/H₂O₂/UV A) MPDSA, B) AASA, C) PNTSA and D) DNBSA.

Fig. 5.1 Anaerobic degradation.
Fig. 5.1a Schematic representation of aerobic and anaerobic biodegradation of sulphonates.

Fig. 5.2 Different path ways of aerobic desulfonation of aromatic sulfonic acids.

Fig. 5.3 Colonies of *Arthrobacter* species on a nutrient agar plate.

Fig. 5.4 Effect of different carbon sources on degradation of MPDSA, AASA, PNTSA and DNBSA (pH-6.8, 200 rpm and 30°C).  
Degradation of test compound (%) and \( \uparrow \) growth of bacteria (g/L).

Fig. 5.5 Effect of concentration of glucose on degradation of MPDSA, AASA, PNTSA and DNBSA (pH-6.8, 200 rpm and 30°C).  
Degradation of test compound (%), \( \square \) consumption of glucose (%) and \( \uparrow \) growth of bacteria (g/L).

Fig. 5.6 Effect of pH on degradation of MPDSA, AASA, PNTSA and DNBSA.  
(Concentration of glucose 1%, 200 rpm and 30°C).  
Degradation of test compound (%) and \( \uparrow \) growth of bacteria (g/L).

Fig. 5.7 Effect of initial concentrations of the test substances (0.5% glucose, pH 6.7, 200 rpm and 30°C).

Fig. 5.8 Degradation of test compounds and growth of the bacteria under optimized conditions. (Concentration of test compounds 0.1 mM, concentration of glucose-1%, pH – 6.8, 200 rpm and 30°C). \( \Theta \)
Concentration of test compound (%), -■- concentration of glucose and -▲- growth of bacteria (g/L).

Figs. 5.9 HPLC chromatograms of I) MPDSA, II) AASA, III) PNTSA and IV) DNSDA; a: before degradation; b: after 5 days of degradation.

Table 1.1 Types of industries in Hyderabad region.

Table 1.2 Chemical structures of benzene and stilbenesulfonic acids studied in the present investigation

Table: 1.3 Chemical structures and abbreviations of benzene derivatives

Table 1.4 Common name, Abbreviation, IUPAC name and CAS registry number of the studied aromatic sulfonic acids

Table 2.1 Oxidation potentials of selected oxidizing agents.

Table 2.2 Band positions of some common semiconductor photocatalysts in aqueous solution at pH=1.

Table 3.1 The optimized ESI-MS parameters

Table 3.2 Optimized time program for the gradient elution of test compounds by LC

Table 3.3 Retention data

Table 3.4 ESI-MS data and assignments

Table 3.5 Contd., ESI-MS data and assignments

Table 3.6 Linearity, limits of detection and quantification data

Table 3.7 Concentration (%RSDs) of sulfonic acids in industrial wastewaters
Table 4.1 COD and BOD of effluents before and after treatment by TiO$_2$/UV and Fe$^{2+}$/H$_2$O$_2$/UV processes

Table 5.1 Characteristics of *Arthrobactor* species

Table 5.2 Bacterial growth with different carbon source

Table 5.3 Bacterial growth at different pH