The overall objective of this dissertation research is to study on the preparation of organosilica membrane and application to use in gas separation (GS) and reverse osmosis (RO) applications. Two types of organosilica materials; TTESPT and BTESE were chosen for this study. At first we focus on the development of 2,4,6-Tris[3(triethoxysilyl)-1-propoxy]-1,3,5-triazine (TTESPT) membrane by varied the firing effect and performed the gas separation performance test. The TTESPT-derived silica membrane exhibits a significant degree of selectivity for C$_3$H$_6$–C$_3$H$_8$ ~37 at a permeation temperature of 50 °C, which greatly surpasses the upper-bounds of selectivity and permeance trade-off of carbon membranes. We also studied by varied the water ratio for this membrane in gas separation and reverse osmosis (RO). By adjusting the H$_2$O/TTESPT molar ratio, we found a promising technique for tuning the pore network of TTESPT membranes. A TTESPT membrane with a high H$_2$O/TTESPT molar ratio exhibited a high degree of selectivity for H$_2$/SF$_6$ (greater than 4000) at a permeation temperature of 200 °C and demonstrated high sodium chloride (NaCl) rejection (>98.5%) with water permeability of >1 x 10$^{-12}$ m$^3$ m$^{-2}$ s$^{-1}$ Pa$^{-1}$ under operating conditions of 1 MPa and 60 °C during a RO experiment. In case of BTESE membranes, more optimization study was emphasized. The mechanisms for solute transport in the BTESE RO membrane were investigated using three different aqueous solutions of sodium chloride (NaCl), ethanol (EtOH) and isopropanol (IPA). It was noteworthy that the rejection of alcohols decreased with an increase in the RO operating temperature, while the electrolyte rejection remained almost constant. The BTESE membranes exhibited high thermal robustness under the long-term testing conditions, delivering salt rejections >98% until the end of the testing period (50 h). The BTESE membranes could also be regenerated after use in the gas and RO experiments, thus demonstrating robust properties. We also found that for BTESE samples fired in N$_2$ environment are more hydrophobic compared with the sample fired in air environment and can be proven by contact angle and H$_2$O adsorption results. In term of separation performance, the permeance of gases and H$_2$O were clearly dependent on WR. In addition, the relationship between gas and liquid permeances was correlated by assuming He gas as a predictor of water permeance, N$_2$ gas as a predictor for IPA and SF$_6$ gas as a predictor for NaCl permeance. BTESE was more pronounced to have fouling by using DTAB foulant compared with BSA, SA and SDS foulants. It was found out the optimize cleaning condition of fouled BTESE membrane by DTAB was by using hot water at 80 °C for 30 minutes.