Chemical absorption with alkanolamines processes are commonly applied for natural gas purification. The knowledge of CO$_2$, H$_2$S, hydrocarbons and mercaptans solubilities in aqueous alkanolamine solutions is important in acid gas removal process simulation and design. In previous works, alkanes, aromatics and mercaptans solubilities in different aqueous alkanolamine solutions have been successfully represented by using the PR-CPA EoS. In this work, the PR-CPA EoS with a pseudo-chemical reaction approach is developed and applied to describe the solubility of acid gases in aqueous alkanolamines solutions. The results are in good agreement with a wide range of experimental data. Other relevant properties such as water content, electrolytes speciation and enthalpy of absorption are accurately predicted by PR-CPA EoS.