# DEVELOPMENT OF STEADY STATE MODEL EQUATIONS FOR OPTIMIZATION OF HIGH PRESSURE CARBAMATE CONDENSER IN UREA PLANT

**Dagde K.K**
Rivers State University
**Nigeria**
dagde.kenneth@ust.edu.ng

**Akpa J.G**
Rivers State University
**Nigeria**
akpa.jackson@ust.edu.ng

**Wele G.N**
Rivers State University
**Nigeria**
Blessedlife89@gmail.com

## ABSTRACT

The research for the development of steady state models to predict optimal yield of High Pressure Carbamate Condenser (HPCC) has been carried out. Different urea production processes were discussed and literatures related to urea production were reviewed. The Stamicarbon design for Urea production was chosen for this research. The research applies the principles of conservation of mass and energy to develop the steady state concentration and temperature models of the High Pressure Carbamate Condenser (HPCC) which was modeled as a plug flow reactor. The kinetics of the reaction was studied from the fundamentals of the chemical reaction involving Ammonia ($NH_3$) and carbon dioxide ($CO_2$) to form the intermediate product called Urea Carbamate and eventually dissociate to give Urea. The mathematical models developed were simulated using numerical $4^{th}$ – order ode 45 algorithm and profile plots were obtained. The research shows how the reactants deplete to form the desired product at various points along the reactor, showing the concentrations of the intermediate and final products along the High Pressure Carbamate Condenser (HPCC). The yield of the model prediction was compared to the Urea plant values obtained from Notore Chemical Industries PLC. The yield of Urea Carbamate from the developed model gave a higher value of 46% instead of the normal plant yield of 40%, a deviation of 6%.

**Keywords:** Urea Carbamate, Plug Flow Reactor, High Pressure Carbamate Condenser, Ammonia, Carbon dioxide.