UREA MANUFACTURE

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- **Raw materials:**

  Ammonia (NH_3: 99.5 %, Water max: 0.5 % wt), **Carbon Di-Oxide** (CO_2: 97 % (Dry basis), S (max): 0.25 %, H_2 (max): 1.5 %, N_2: 1.25 %)

- **Raw material and utilities consumption per M.T. of Urea:**

  Liquid Ammonia : 0.575 MT, Gaseous CO_2 : 0.74 MT

- **Reaction :-** It is a two steps reaction

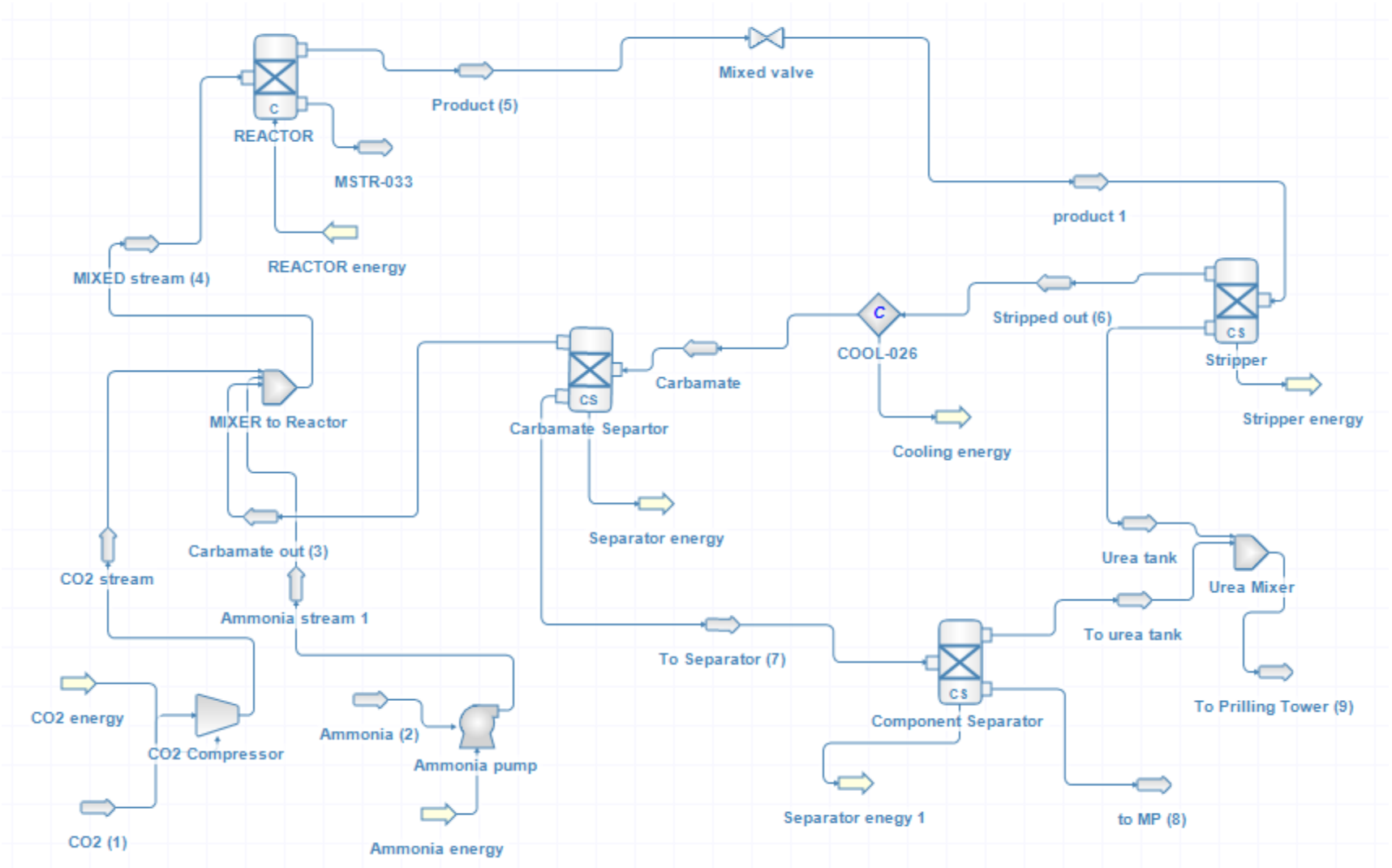
$$NH_3 + CO_2 \rightarrow NH_2COONH_4 \qquad \Delta H = -117KJ/mol \qquad P = 110\ atm, T = 160^0C$$

$$NH_2COONH_4 \rightarrow NH_2CONH_2 + H_2O \qquad \Delta H = 15.5KJ/mol \qquad P = 160\ atm, T = 180^0C$$

- **Process Description:-**

Urea is produced by synthesis of liquid ammonia and gaseous carbon dioxide. In reactor, ammonia and carbon dioxide react to form ammonium carbamate, a portion of which dehydrates to form urea and water. The carbon dioxide stream (1) is drawn at urea Plant battery limits at about 1.4 atm pressure and about 40 degree Celsius temperature enters the centrifugal compressor and leaves pressure about 162 atm. Ammonia stream (2) is drawn and pumped to 23 atm pressure by means of centrifugal pump. The Carbamate stream (3) is recycled again into the mixer. These three streams are mixed in the mixer and the mixed stream (4) is fed to the reactor. Then the two reactions take place in the reactor to form carbamate solution, urea, water and unreacted ammonia and carbon dioxide as a product stream (5). Then the product stream is passed through stripper. In stripper the separation of urea and carbamate solution takes place. The urea which is separated from stripper contains 70 % urea and 30 % water. The further urea separation takes place in Carbamate separator. The heated solution coming out from stripper i.e. stripped out (6) is passed through the carbamate condenser. In carbamate separator, the carbamate solution is separate out and is recycled back to the mixer. The other stream coming out from carbamate separator contains urea and unreacted ammonia and carbon dioxide. This stream (7) is passed through another separator where urea is separated and the unreacted ammonia and carbon dioxide is fed to Medium pressure (MP) stream (8). The urea produced from stripper and above separator is mixed and send it to the prilling tower (9).

Flow Sheet for the Manufacture of Urea



Result Summary Table:

Component	Material Streams (kg/s)								
	Stream 1	**Stream 2**	**Stream 3**	**Stream 4**	**Stream 5**	**Stream 6**	**Stream 7**	**Stream 8**	**Stream 9**
CO_2	0.0085	_	_	0.0085	0.0012	0.0012	0.0012	0.0012	0.0
NH_3	_	0.0066	_	0.0066	0.00099	0.00099	0.00099	0.00099	0.0
Ammonium Carbamate	_	_	0.0219	0.015	0.02196	0.02196	0.0	0.0	0.0
Urea	_	_	_	_	0.00461	0.00109	0.00109	0.0	0.00461
Water	_	_	_	_	0.00138	0.00105	0.00105	0.000528	0.000856
Temperature (K)	941.81	1667	443.15	1426.2	1427.4	1427.4	443.15	443.15	610.5
Pressure (KPa)	17630.5	24310.7	24318.9	14793.4	24318.9	24318.9	24318.9	24318.9	24318.9

Urea production in one processing unit is 400 kg/day. The conversion can be increased with further operation.

REFERENCES:

1. Process manual of Rashtriya Chemicals And Fertilizers Limited (RCF), Thal unit.
2. www.pubchem.ncbi.nlm.nih.gov
3. www.wikipedia.com