Vapour phase production of Ammonium Nitrate

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Introduction-

Ammonium Nitrate(NH_4NO_3) is the ammonium salt of nitric acid. It is majorly used in fertilizers used in agriculture due to high content of nitrogen in it. Other major use of ammonium nitrate is as a component in explosives. Ammonium nitrate itself is not explosive in nature but it readily forms explosive mixture with fuel oils, azides etc. Dissolution of ammonium nitrate in water is endothermic in nature and is highly soluble with it.

Ammonium nitrate is produced by neutralization reaction between Ammonia gas(NH_3) and concentrated Nitric acid(HNO_3)(70-90%). In this method ammonium nitrate is produced by vapour phase reaction between ammonia and nitric acid.

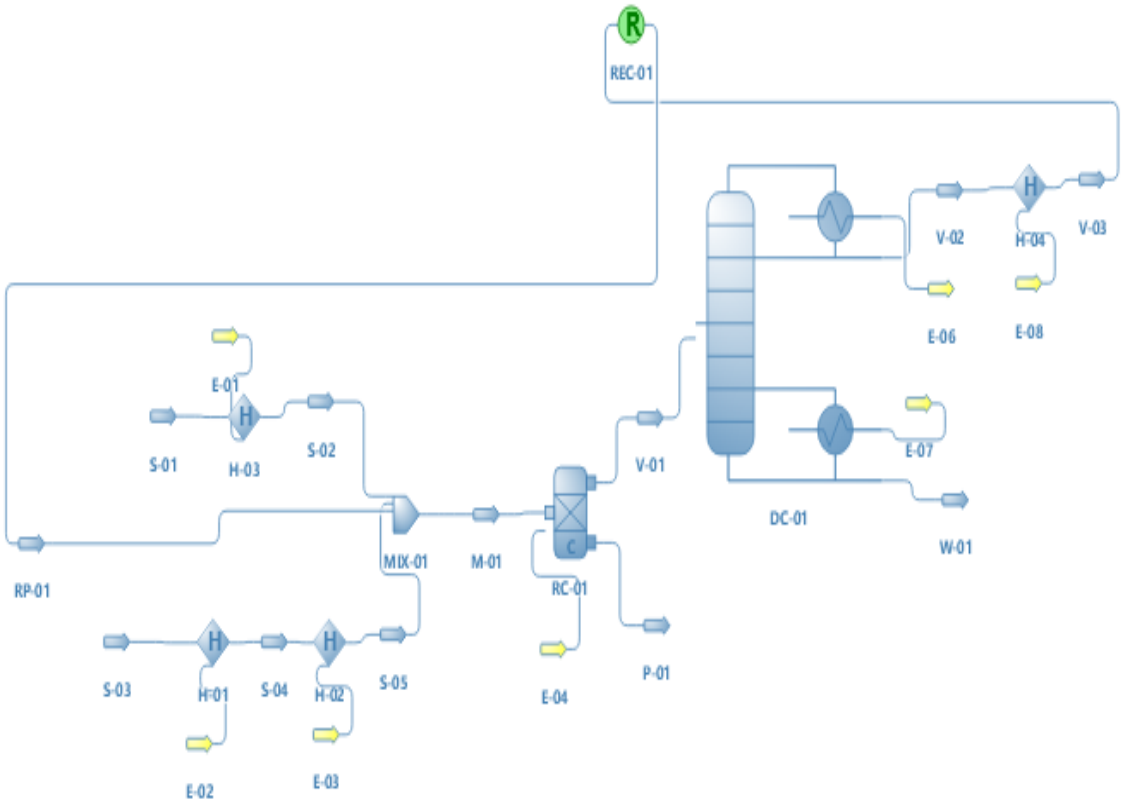
Process Description

Ammonia gas and nitric acid are taken in 1:1 mole ratio. Ammonia gas is preheated to 145°C and concentrated nitric acid is first preheated to 95°C in stainless steel unit and then to 160°C in a tantalum unit to avoid corrosion due to high temperature nitric acid. They both are then reacted in a vapour phase reactor at temperature of 250°C and pressure of 1 atm. This neutralisation reaction produces molten ammonium nitrate with almost 98% conversion. Unreacted reactants are separated in vapour form along with steam from the reactor. Steam is partially condensed using distillation column to be used for the next reactor and the left unreacted reactants are recycled. This molten ammonium nitrate is then converted into prills in a prilling tower to be used

further or it can be cooled and crushed into fine pieces. This overall process is also known as stengel process.

Storage of Ammonium nitrate should be done with proper care since it is hygroscopic in nature. Temperature conditions need to be maintained properly so that decomposition of ammonium nitrate does not occur.

Flowsheet-



Flowsheet for vapour phase production of ammonium nitrate

Results-

Vapour phase production of ammonium nitrate									
Object	W-01	V-03	V-01	S-03	S-01	RP-01	P-01	M-01	
Temperature	99.9788	160	250	25	25	160	250	158.326	C
Pressure	1.01325	1.01325	1.01325	1.01325	1.01325	1.01325	1.01325	1.01325	bar
Mass Flow	94.9266	1394.58	1489.53	928	230	1394.58	1052.85	2542.38	kg/h
Molar Flow	5.267	80.9258	86.1946	18.691	13.5052	80.9258	13.2059	112.538	kmol/h
Molar Flow (Mixture) / Ammonia	1.12619E-13	76.5178	76.5196	0	13.5052	76.5178	0.0296097	89.6871	kmol/h
Mass Flow (Mixture) / Ammonia	1.91796E-12	1303.14	1303.17	0	230	1303.14	0.504268	1527.42	kg/h
Molar Flow (Vapor Phase) / Ammonia	0	76.5178	76.5196	0	13.5052	76.5178	0	89.6871	kmol/h
Mass Flow (Vapor Phase) / Ammonia	0	1303.14	1303.17	0	230	1303.14	0	1527.42	kg/h
Molar Flow (Mixture) / Ammonium Nitrate	8.57614E-09	8.28869E-50	8.57613E-09	0	0	8.28869E-50	13.1395	8.26751E-50	kmol/h
Mass Flow (Mixture) / Ammonium Nitrate	6.86434E-07	6.63427E-48	6.86434E-07	0	0	6.63427E-48	1051.68	6.61732E-48	kg/h
Molar Flow (Mixture) / Nitric acid	0.000890995	0.267261	0.268152	13.1402	0	0.267261	4.78865E-08	13.4074	kmol/h
Mass Flow (Mixture) / Nitric acid	0.0561441	16.8409	16.897	828	0	16.8409	3.01746E-06	844.838	kg/h
Molar Flow (Vapor Phase) / Nitric acid	0	0.267261	0.268152	0	0	0.267261	0	13.4074	kmol/h
Mass Flow (Vapor Phase) / Nitric acid	0	16.8409	16.897	0	0	16.8409	0	844.838	kg/h
Molar Flow (Mixture) / Water	5.26611	4.14077	9.40688	5.55084	0	4.14077	0.0367804	9.4435	kmol/h
Mass Flow (Mixture) / Water	94.8704	74.5972	169.468	100	0	74.5972	0.662609	170.127	kg/h
Molar Flow (Vapor Phase) / Water	0	4.14077	9.40688	0	0	4.14077	0	9.4435	kmol/h
Mass Flow (Vapor Phase) / Water	0	74.5972	169.468	0	0	74.5972	0	170.127	kg/h