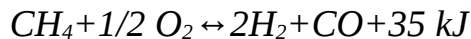
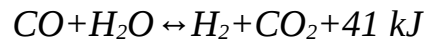




b) conversion of methane by oxygen:



c) CO steam reforming:



The total conversion process of CH_4 with water vapor:

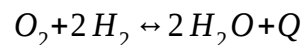
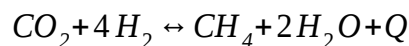


Methods of separation of CO_2 , CO , H_2S , O_2 , Ar , CH_4 from nitric mixture:

Wet method:

a) chemisorption by alkaline solutions: CO_2 and H_2S (ethanolamine, diethanolamine, K_2CO_3 solution); CO (copper acetate ammonia solution);

b) hydrogenation:



The dry method - adsorption by solid adsorbents

The process is carried out at $T = 420-500^\circ\text{C}$, $P = 32 \text{ MPa}$, on the catalysts - $Fe_{\text{porous}}/Al_2O_3$, K_2O , CaO , SiO_2 , with a ratio of $N_2:H_2 = 1:3$ and the reverse process speed $V = 15,000-25,000 \text{ h}^{-1}$. The productivity of the process is $P = 20-40 \text{ tons per day}$ with 1 m^3 of catalyst, the degree of ammonia conversion is $X_{NH_3} = 15-20\%$.

c) washing with liquid nitrogen at -190°C (CO , CH_4 , Ar).

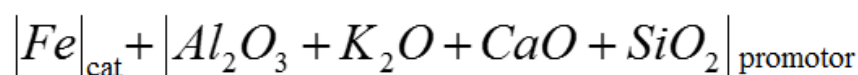
Industrial methods of ammonia production depending on the pressure are divided into:

- under low pressure up to 10 (10-15) MPa;
- under average pressure 20-30 (25-60) MPa;
- high pressure 75-100 (60-100) MPa.

Physical and chemical bases of ammonia synthesis process

The exothermic, reversible; ratio of $N_2:H_2 = 1:3$; because the process is by reducing the amount necessary to reduce T and increase R (much lower T disadvantageous because it decreases the speed of the process and the performance of $T_{\text{optimal}} = 400-500^\circ\text{C}$).

The maximum conversion reaches 97% at $T = 400^\circ\text{C}$ is achieved at $P > 350 \text{ MPa}$. Lowering the pressure increases the equilibrium yield of ammonia, so apply very high pressure is disadvantageous ($P_{\text{optim}} = 32 \text{ MPa}$). Industrial ammonia synthesis catalyst-GIAP:



Also as catalysts of process apply: Mn , Rh , W , Re , U , Os , Pt .