REDUCTION OF THE THICKNESS OF THE BOUNDARY FILM AT RECTIFICATION OF HYDROCARBONIC MIXES WITH APPLICATION OF DRY DISTILLATION

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Abstract: The paper describes a negative impact of water vapor from the distillation of hydrocarbon mixtures. It is substantiated a promising method of primary distillation process for oil and raw materials.

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Introduction

Rectification is carried out at interaction of phases with various concentration of a distributed component which is transferred through boundary diffusive layer, under formation between contacting phases. Sharp decrease in concentration difference occurs in the boundary layer having thickness δ_c; it might become closer to linear since in this flow region the speed of the process is determined by the molecular diffusion, and the role of convective diffusions is small. Such decrease of mass exchange is caused by increase of inhibitory effect of friction forces between the phases at the interface; amplification of inhibitory effect of surface tension at the boundary of liquid phase also explains this process (Kasatkin, 1973; Kafarov, 1979; Dytnersky, 1995). The formation of the hydrodynamic boundary layer near the interface leads to the emergence of diffusion boundary film of thickness δ, typically much thinner than δ_c.

In a stream kernel the mass transfer is carried out basically by turbulent pulsations, therefore concentration of distributed substance in a stream kernel is practically constant. Obviously, the basic resistance to carrying over diffusive mass transfer process is concentrated in the interface between contacting phases (Kafarov, 1979; Dytnersky, 1995).

Experimental

One of ways to intensify the mass transfer process is reducing the interface of phases - of the films.

There are a number of interpretations and models which explain occurring processes in the interface of phase. One of extended is Lewis and Whitman's two-film model. According to this model motionless or laminar moving films are formed on contact surfaces in both parties of phases; the substance transfer is carried out only by molecular diffusion. These films separate a surface of contacting phases from a stream kernel in which concentration is practically constant; all changes of substance concentration occur in a film (Kafarov, 1979; Dytnersky, 1995; Aynshteyn, 2003).

Providing integration of the film model equation

$$M = -D \cdot (dc/dn) \cdot F, \qquad (1)$$

leads to expression

$$M = F\,(D/\delta)(c_0 - c_b), \qquad (2)$$

where δ - is a thickness of a boundary film; c_0 - average concentration in a kernel of phase; c_b - concentration on interface of phases; D - factor of molecular diffusion of distributed substance; F - a surface, normal to a diffusion direction; dc/dn - a gradient of concentration of diffusive substance.

Comparing last equation with the equation

$$M = \beta(y - y_b)F \qquad (3)$$

we will receive:

$$\beta = D/\delta \qquad (4)$$

where β - is a factor of mass transfer of the steaming agent.

Consequently, of the received expression we obtain the equation for a thickness of the interfacial diffusion film

$$\delta = D/\beta , \qquad (5)$$

From this equation we can see that parameter β is inversely proportional to film's thickness δ.

Thicknesses of interface films created by hydrocarbonic steaming agents (steams from gas fractionation unit(GFU), light (LN) and heavy naphtha) and water steam (δ_{ws}) are defined at steaming of some fractions (with limits of boiling: fr.1 - 60-80 ^oC, fr.2 - 120-130 ^oC and fr.3 - 170-180 ^oC).

Results

Results of calculations show (Figure 1) that the thickness of film created by water steam (WS) at steaming of specified above fractions fluctuates within $3.95\cdot10^{-6}$ - $4.49\cdot10^{-6}$ m, in steams from GFU this indicator has decreased down to $0.71\cdot10^{-6}$ - $0.75\cdot10^{-6}$ m, and at steaming in steams of LN to $0.45\cdot10^{-6}$ - $0.47\cdot10^{-6}$ m, and in steams of HN to $0.32\cdot10^{-6}$ - $0.36\cdot10^{-6}$ m.

FIGURE 1. THICKNESS OF A FILM CREATED BY STEAMING AGENTS AT DIVISION FROM A MIX OF FRACTIONS: ▒ - FR.1, ■ - FR.2, □ - FR.3.

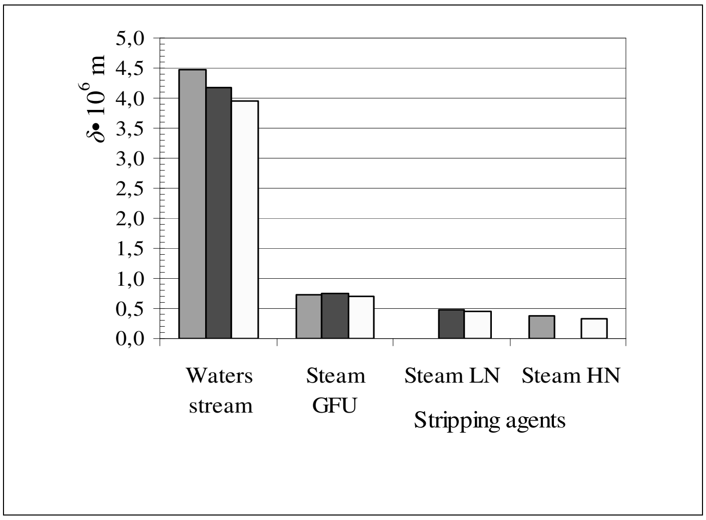
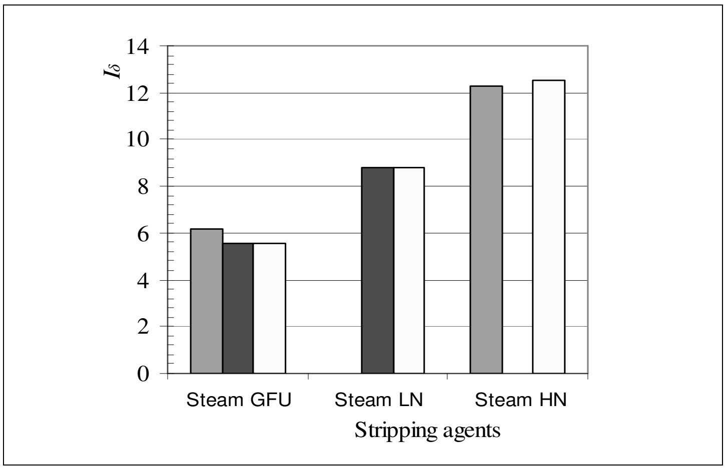


FIGURE 2. DEGREE OF REDUCTION OF A THICKNESS OF BOUNDARY FILMS CREATED BY STEAMING AGENTS IN A STEAM PHASE AT FRACTIONS STEAMING: ▒ - FR.1, ■ - FR.2, □ - FR.3.



There were received thickness ratios for boundary films created with water steam and with steams of the hydrocarbons; they exhibit degree of thickness reduction $I_{\delta} = \delta_{ws} / \delta_{y}$. Results of calculations show the decreasing of thickness of boundary films at steaming with application of steams from GFU by 5.8 times; at application of steams of LN and HN it has decreased by 9.3 and 12.6 times accordingly (Figure 2).

Conclusion

Perspective of application of the dry distillation method of oil and gas condensate mixes proves to be true according the provided study results. This is supported by the facts of decreasing of thickness of boundary film by 9.2 times in application of the specified above hydrocarbonic steams as the steaming agent, approximately

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