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Mathematical Equation for Product Selection in Degradation of Plastic and Crude Oil

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***Abstract* – The current communication proposes a mathematical equation to express the relationship of condenser temperature with boiling point of distillate. Condenser temperature is directly related to cooling water temperature and by its variation it is possible to select distillate towards a particular boiling point. The proposed equation can be used to design a reactor for the product selection, in terms of boiling point, of heavy hydrocarbons like crude oil or waste polyolefin by cracking and distillation. It can be expressed as:**

$$\Delta T = \frac{\delta T}{In\left\{\dfrac{\delta T - \delta' T}{2\delta T - \delta' T}\right\}} = \frac{q''}{h}$$

where symbols have their usual meaning .

***Keywords* – Mathematical Equation, Distillate Selection, Crude Oil, Waste Polyolefin, Distillation, Degradation.**

Diversified product ranges are the common problem in the degradation and cracking of heavier hydrocarbons, like as crude oil or polyolefins (Pant, 2011) and initially cracked fragments require further processing for its application as a potential fuel. For this purpose fuel was generally passed through fractional distillation column to separate those in terms of boiling point ranges. If selection towards deferent boiling ranges was achieved it will save both time and money. This communication presents a mathematical model for product selection in cracking or degradation reaction.

The average logarithmical temperature difference between a vapour and the cooling liquid flowing in the condenser ΔT, can be written for a successive distillation unit follows the following equation (Risto, 1981):

$$\Delta T = \frac{\delta T / m}{In\left\{\dfrac{\delta o T - \sum_1^N \delta' T - \delta T}{\delta o T - \sum_1^N \delta' T - \delta T - N\dfrac{\delta T}{m}}\right\}} \qquad (1)$$

Where $\delta_0 T$ = difference between highest and lowest temperature of the distilling liquid ($T_I - T_C$), δ'T = boiling point elevation of the distilling liquid, m= distillation stages, N= distillation units, δT is the flashing temperature drop of the distilling liquid as it follow through all of the distillation stages of one distillation unit.

For a single distillation stage and unit m=0; N=0

Then equation 1 is modified as:

$$\Delta T = \frac{\delta T}{In\left\{\dfrac{\delta o T - \delta' T + \delta T}{\delta o T - \delta' T + 2\delta T}\right\}} \qquad (2)$$

In case of negligible temperature difference between highest and lowest temperature of distilling liquid $\delta o T$ is likely to equals to zero. Then equation 2 can be written as:

$$\Delta T = \frac{\delta T}{In\left\{\dfrac{\delta T - \delta' T}{2\delta T - \delta' T}\right\}} \qquad (3)$$

Heat transfer between the liquid-steam interface and the cooling water (Spaldhg, 1954) accords with the equation 4 (where h is a constant heat transfer coefficient, then the rate of external heat supply area of condenser to unit area of vaporizing surface

$$q'' = \Delta T\, h \qquad (4)$$

From equation 3 and 4

$$\Delta T = \frac{\delta T}{In\left\{\dfrac{\delta T - \delta' T}{2\delta T - \delta' T}\right\}} = \frac{q''}{h} \qquad (5)$$

In words:

$$\text{Temperature of vapour} - \text{cooling liquid} = \left[\frac{\text{bp of distillate-temperature of cooling liquid-b p elevation of the distilling liquid}}{\text{In}\left\{\dfrac{\text{b p of distillate-temperature of cooling liquid-b p elevation of the distilling liquid}}{\text{2(b p of distillate-temperature of cooling liquid)-b p elevation of the distilling liquid}}\right\}}\right]$$

$$= \frac{\text{external heat supply/area of condenser}}{\text{heat transfer coefficient}}$$

CONCLUSION

By the proposed equation it is possible to select the boiling point of distillate by the temperature of cooling liquid.

REFERENCES

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