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Parametric survey on the sweetening process; Introduction of new process

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Abstract

Desulphurization of crude oil is an important process used in a petroleum refinery to reduce the sulphur concentration and production of fuel products such as gasoline, jet fuel, kerosene, diesel and heating oil. The operating and geometrical parameters are evaluated in this paper. Therefore, the gained results can be interesting for related industries and can be applicable in process optimization. Results show the lowest amount of index in process is obtained at height higher than 6 cm, between 7 cm and 8 cm, for the light and mid-range oil, respectively.

KeyWords: Nano; Sweetening; Oil; Bed; Diameter; Catalyst.

1. Introduction

Methods of removing sulfur dioxide from sour oil and furnace exhaust gases have been studied for over 150 years. Early ideas for sour oil and flue gas desulfurization were established in England around 1850 [1]. With the construction of large-scale power plants in England in the 1920s, the problems associated with large volumes of SO_2 from a single site began to concern the public. The SO_2 emissions problem did not receive much attention until 1929, when the House of Lords upheld the claim of a landowner against the Barton Electricity Works of the Manchester Corporation for damages to his land resulting from SO2 emissions. Shortly there after, a press campaign was launched against the erection of power plants within the confines of London [1]. This outcry led to the imposition of SO2 controls on all such power plants. The first major desulfurization unit at a utility was installed in 1931 at Battersea Power Station, owned by London Power Company. In 1935, an desulfurization system similar to that installed at Battersea went into service at Swansea Power Station [2 and 3]. The third major desulfurization system was installed in 1938 at Fulham Power Station. These three early large-scale desulfurization installations were abandoned during World War II. Large-scale desulfurization units did not reappear at utilities until the 1970s, where most of the installations occurred in the United States and Japan. Desulfurization of crude oil is an important process used in a petroleum refinery to reduce the sulphur concentration and production of fuel products such as gasoline, jet fuel, kerosene, diesel and heating oil. So, the resulting fuels meet environmental protection standards. The challenge of fulfilling the world’s growing transportation energy needs is no longer a simple issue of producing enough liquid hydrocarbon fuels [3]. This challenge is instead accentuated by a complex interplay of environmental and operational issues. Environmental issues include societal demands that liquid hydrocarbon fuels be clean and less polluting [4]. The emergence of new refining processes and the increasing use of new forms of energy production, e.g., fuel cells, exemplify operational issues. Together, these trends are driving the need for deep desulfurization of diesel and jet fuels.

This paper focuses on the configuration of synthesized nano particles which are affected on the sweetening of sour oil.

1.1. Desulphurization processes

In the past two decades petroleum refining has changed extensively and the fortunes of hydro treating, in particular, have witnessed a sea change [5]. Hydro-treaters now occupy a central role in modern refineries and more than 50% of all refinery streams now pass through hydro-treaters for conversion, finishing, and pre-treatment purposes [6 and 7]. Hydro-desulfurization is the largest application of catalytic technology in terms of the volume of material processed. On the basis of usage volume, HDS catalysts are ranked third behind catalysts used for automobile emission control and FCC. Commercial hydro treating catalysts are, typically, Molybdenum or Zinc. Molybdenum, known for its high hydrogenation activities, is preferred as a promoter when feed stocks containing high amounts of nitrogen and aromatics need to be processed.

It seems, nano particles such as metal oxides can promote the heating and cooling process [8 and 9]. For example, the nano substances like; metal oxides can enhanced the thermal stability of some of materials [10].

In this study, Molybdenum dioxide nano catalyst (spherical and cylindrical) is used for sweetening process of sour oil. So, the operating and geometrical parameters are evaluated in this paper. Therefore, the gained results can be interesting for related industries and can be applicable in process optimization.

2. Materials and Method

All equipments are made up of glass since it is non corrosive material and makes the oil tracking in catalytic bed possible.

A hot water jacket is heated the storage tank and a stirrer homogenize heat in the feed oil uniformly. Higher temperature helps oil moving easily through the set up. Surely, temperature and pressure is controlled in feed tank, necessarily. The oil is pumped upward and passes through a filter and then is fed into the reactor with an adjusted flow rate. Feed oil is distributed on the catalytic bed by a glass distributor. Changing the operating conditions in synthesis of Molybdenum dioxide causes different structures of this metal dioxide.

3. Results and Discussion

Experiments are conducted to show the effect of operating temperature, pressure, catalyst diameter, oil superficial velocity and also bed height and bed diameter on the quality of oil sweetening by catalyst. Below curves can introduce the results. The index of process is determined by the fraction of outlet H_2S concentration, C on the inlet concentration of H_2S, C_0. The lower index shows the higher quality of the adsorption process.

3.1. The Effect of Bed Height

The effect of bed height in the process index is investigated for the light and mid range oil. Figure 1 shows the results. The optimum temperature for spherical type of catalyst is considered 45 C. the effect of bed height (5, 6, 7, 8, 9 and 10 cm) is investigated at the optimum temperature, 1.4 atm and 4 cm diameter of bed. According to the Figure 5, the lowest amount of index in process is obtained at height higher than 6 cm, between 7 cm and 8 cm, for the light and mid range oil, respectively.

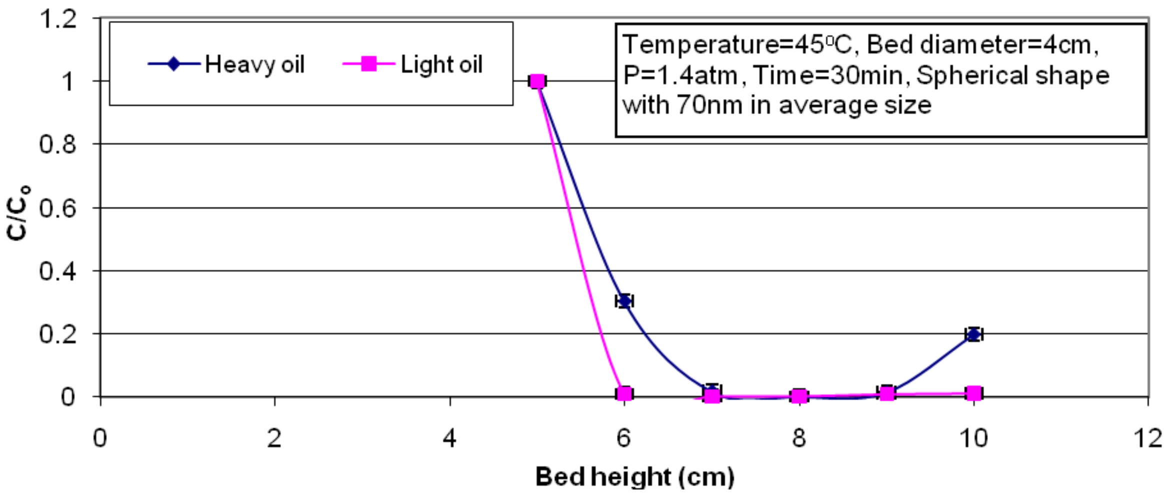

Figure 1. The effect of bed height on the quality of oil sweetening (spherical type).

4. Conclusion

Oil sweetening by nanocatalyst has been not developed industrially, yet. So, finding the optimum conditions of this operation is interesting. This work focouses on finding the optimum operation conditions and geometerical properties of cylindrical adsorbtion reactor and the diameter and shape of nanocatalyst for oil swetening, experimentally. According to the obtained results, the lowest amount of index in process is obtained at height higher than

6 cm, between 7 cm and 8 cm, for the light and mid-range oil, respectively.

References

[1] Yuxiao Niu, Mingyang Xing, Baozhu Tian, Jinlong Zhang, 2012, ‘’Improving the visible light photocatalytic activity of nano-sized titanium dioxide via the synergistic effects between sulfur doping and sulfation, ’’Applied Catalysis B: Environmen., **115–116** (5) pp. 253-260.

[2] Rao Mumin, Song Xiangyun, Cairns Elton J., 2012, ‘’Nano-carbon/sulfur composite cathode materials with carbon nanofiber as electrical conductor for advanced secondary lithium/sulfur cells,’’ J. Power Source., **205** (1), pp. 474-478.

[3] Zhang Yongguang, Zhao Yan, Konarov Aishuak, Gosselink Denise, Soboleski Hayden Greentree, Chen P., 2013, ‘’A novel nano-sulfur/polypyrrole/graphene nanocomposite cathode with a dual-layered structure for lithium rechargeable batteries,’’ J. Power Source., **241** (1), pp. 517-521.

[4] Hosseinkhani M., Montazer M., Eskandarnejad S., Rahimi M.K., 2012, ‘’Simultaneous in situ synthesis of nano silver and wool fiber fineness enhancement using sulphur based reducing agents, ’’Colloids and Surfaces A: Physicochem. Eng. Aspect., **415** (5), pp. 431-438.

[5] Christoforidis Konstantinos C., Figueroa Santiago J.A., Fernández-García Marcos, 2012, ‘’Iron–sulfur codoped TiO_2 anatase nano-materials: UV and sunlight activity for toluene degradation, ’’Applied Catalysis B: Environment., **117–118** (18), pp. 310-316.

[6] Balouria Vishal, Kumar Arvind, Samanta S., Singh A., Debnath A.K., Mahajan Aman, Bedi R.K., Aswal D.K., Gupta S.K., 2013, ‘’Nano-crystalline Fe_2O_3 thin films for ppm level detection of H_2S,’’Sensors Actuators B: Chemical, **181**, pp. 471-478.

[7] Habibi R., Rashidi A. M., Towfighi Daryan J., Alizadeh A., 2010,"study of the rod – like and spherical nano ZnO morphology on H2s removal from natural gas". Appl. Surf. Sci., **257**, pp. 434- 439.

[8] Novochimskii II., Song CH., Ma X., Liu X., Shore L., Lampert J., Farrauto R. J., 2004, "Low temperature H2S removal from steam containing gas mixtures with ZnO for fuel cell application. 1. ZnO particles and extrudates". Ene. Fuel. , **18**, pp. 576-583.

[9] Habibi R., Towfighi Daryan J., Rashidi A.M., 2009, Shape and size-controlled fabrication of ZnO nanostructures using noveltemplates, J. Exp. Nanosci. **4** (1) 35-45.

[10] Farahbod Farshad, Bagheri Narges, Madadpour Fereshteh, 2013, Effect of Solution Content ZnO Nanoparticles on Thermal Stability of Poly Vinyl Chloride, Journal of Nanotechnology in Engineerin and Medicine. **4** / 021002-1.