

MDEA 脱除焦炉煤气硫化氢的工艺设计

摘要

随着焦化工业的发展,焦化工业的副产物焦炉煤气已经成为我国的大吨位能源和重要的化工资源。未经脱硫处理过的焦炉煤气中的硫化氢(H_2S)不仅会造成严重的环境污染,还会引起催化剂的中毒、导致设备腐蚀、工艺条件恶化,极大的降低了产品的质量以及稳定性,同时还会增加维护和更换设备的经济成本。因此,脱除焦炉煤气中的 H_2S 对于提高焦炉煤气的品质、降低设备腐蚀、减少环境的污染以及提升回收产品的质量具有十分重要的意义。本文针对这一问题,使用 Aspen Hysys 过程模拟软件对以 N-甲基二乙醇胺(MDEA)为吸收主体的复配醇胺吸收工艺脱除焦炉煤气中 H_2S 的过程进行模拟计算并优化。

本次模拟将首先根据现有的脱硫工艺流程图,在 Aspen Hysys 软件上搭建脱硫工艺系统。然后对流程中影响 H_2S 脱除率的因素进行探讨,总结原料气温度、吸收塔操作压力和吸收塔塔板数对于 H_2S 脱除率的影响规律,并得出最佳的参数来对流程进行优化。

优化完成后,本次模拟还列举以不同组合及配比的复配醇胺溶液作为吸收液的方案。并对这些方案的 H_2S 脱除率、经济效益和能量损耗等方面进行分析与评估,比较不同方案的优劣。

模拟的结果表明,使用单一的 MDEA 溶液为吸收剂时,经济成本最低,但脱除效果较差,不建议选用。使用 MDEA+哌嗪(PZ)的复配醇胺溶液时,脱除效果最好,能量损失也低,但因 PZ 的单价偏高,因此该方案的成本也较高。使用 MDEA+环丁砜(sulfolane)为吸收剂时,脱除效果较好,能够达到要求,且环丁砜的单价相比 PZ 较低,因此该方案的经济成本也较低。

关键字: 焦炉煤气; H_2S 脱除; Aspen Hysys; MDEA; 醇胺溶液

Process design of removing hydrogen sulfide from coke oven gas by MDEA

Abstract

With the development of coking industry, coke oven gas, a by-product of coking industry, has become a large tonnage of energy and an important chemical resource in China. Hydrogen sulfide (H_2S) in undesulfurized coke oven gas will not only cause serious environmental pollution, but also lead to deactivation of catalysts, corrosion of equipment and deterioration of process conditions, which greatly reducing the quality and stability of products, and increasing the economic cost of maintenance and replacement of equipment. Therefore, removing H_2S from coke oven gas is of great significance for improving the quality of coke oven gas, reducing equipment corrosion, reducing environmental pollution and improving the quality of recycled products. Aiming at this problem, this paper used Aspen Hysys process simulation software to simulate and optimize the process of removing H_2S from coke oven gas in a compound alkanolamine absorption process with methyldiethanolamine (MDEA) as the main component of the absorbent.

Firstly, the desulfurization process system was built, which was on the Aspen Hysys software according to the existing desulfurization process flow chart. Then, the factors affecting the removal rate of H_2S in the process were discussed. The influence rules of the temperature of the raw material, operating pressure of the absorption tower and the number of absorption tower plates on H_2S removal were summarized, and the optimal parameters were obtained to optimize the process.

After the optimization, amine blends with different combinations and ratios were listed as the experimental schemes. The H_2S removal rate, economic benefit and energy consumption of these schemes were analyzed and evaluated, and the advantages and disadvantages of different plans were compared.

The simulation results showed that when the MDEA aqueous solutions was used as the absorbent, the economic cost was the lowest, but the removal efficiency was low, and it was not recommended. The H_2S removal efficiency of MDEA +

piperazine (PZ) aqueous solutions was the highest and the energy consumption of that was low .However, due to the high unit price of PZ, the cost of this scheme is also high. MDEA+ sulfolane aqueous solution with great removal efficiency could meet the requirements. Besides, the unit price of sulfolane is lower than that of PZ, so the economic cost of this scheme is lower.

Keywords: coke oven gas; H₂S removal; Aspen Hysys; MDEA; alcohol amine solutions

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