

多相流和计算流体力学

水力旋流冷氢箱的流体力学

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摘要 根据流体旋流原理设计了水力旋流冷氢箱, 并根据Froude数及机械能守恒方程确定了冷氢箱尺寸、引流管直径和圆锥管入口直径。考察了水力旋流冷氢箱的压降, 且利用氧吸收法测量了液相体积传质系数, 同时与水平旋转流动冷氢箱进行了比较, 并用流体力学软件模拟了水力旋流冷氢箱的流线。研究表明, 水力旋流冷氢箱相比于水平旋转流动冷氢箱, 在降低压降的同时提高了传质效果。水力旋流冷氢箱在液量为 $10\text{m}^3/\text{h}$ 、气量为 $60\text{m}^3/\text{h}$ 下的液相体积传质系数达到了 0.0256s^{-1} , 而压降低于 20Kpa , 模拟发现水力旋流冷氢箱内流体流线平均长度约为无旋流状态下的4倍, 因此具有良好的气液混合效果。

关键词

[水力旋流](#) [Froude数](#) [冷氢箱](#)

分类号

Hydrodynamic principles of hydrocyclone quench box

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Abstract

A hydrocyclone quench box was designed according to the fluid dynamics of spiral flow. The quench box size, the drainage tube diameter, and the inlet tube diameter were designed based on Froude number and conservation of mechanical energy. The pressure drop of the hydrocyclone quench box was measured, and the liquid volumetric mass transfer coefficient was determined by oxygen absorption. The hydrocyclone quench box was compared with the horizontal flow quench box. The streamline of hydrocyclone quench box was simulated by computational fluid dynamics software. It was found that the pressure-drop and liquid volumetric mass transfer coefficient of the hydrocyclone quench box was better than the horizontal flow quench box. The pressure drop was less than 20 kPa and the liquid volumetric mass transfer coefficient was 0.0256 s^{-1} at $10\text{ m}^3/\text{h}$ liquid flow rate and $60\text{ m}^3/\text{h}$ gas flow rate. Simulation indicated that the average length of streamline under spiralling was 4 times of that under non-spiralling condition, which enhanced mixing for gas and liquid.

Key words

[hydrospiral flow](#) [Froude number](#) [quench box](#)

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