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生物质燃烧碳烟的物化特性及生成机理研究

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Physicochemical properties and formation mechanism of soot during biomass bu

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摘要 以棉花秸秆和木屑为研究对象,设定不同的燃烧工况,在管式炉中进行燃烧并采集碳烟物质,采用TEM、EDS、GC-MS等方法对生物质燃烧过程中生成碳烟的物化特性进行研究,并根据检测结果对碳烟生成机理进行分析和推测。检测及分析结果表碳烟颗粒典型形貌有胶囊状、球状、链状、网状等。燃烧工况影响燃烧过程使碳烟颗粒表现出不同的微观形貌。碳烟生长过伴随着颗粒的碰撞和凝并,形成形貌复杂的链状或网状颗粒聚团。生物质燃烧中碳烟主要由纤维素热裂解生成,成分包括糠醛酚类、醛类、呋喃、烷烃、烯烃等含碳化合物。推测碳烟生成机理为,在生物质燃烧过程中,纤维素发生化学键的断裂与重排CO、CO_2和残炭分子碎片等,而残余碳基再通过重整、脱水、碳化、断键等反应生成各种醛类、酮类等产物,醛类、酮类化合间通过缩聚、环化反应生成苯环结构,再进一步转化为苯酚、甲苯等化合物。

关键词: 生物质燃烧 碳烟 物化特性 生成机理

Abstract: Cotton stalk and wood scraps were burnt in a tube furnace to generate soot under different combustion conditions. Soot particles were sampled and detected by TEM, EDS and GC-MS to study thei physicochemical properties, then the formation mechanics of soot during biomass burning was deduced. results show that the typical morphological structures of soot are capsule-like, spherical, catenulated an reticular. Combustion conditions enfluence the burning process and result in the different morphology of soot. The soot particles collided and coagulated during nucleation and growth of soot, which leads to formation of complicated clustered particles. During biomass burning the soot is mainly generated from pyrolysis of cellulose, which contains furfurans, phenols, aldehydes, furans, alkanes and alkenes. The formation mechanics of soot has been speculated. During burning of biomass, the chemical bonds of cellu fractured and restructured, which generate CO, CO_2, residual carbon molecule fragments, and so on. The residual carbon goes on a series of reactions such as reforming, dehydration, carbonization and bond-bre to generate aldehydes and ketones. And these compounds polymerized and cyclized to form benzene rin structure, and further converted to toluenes and phenols.

Key words: biomass buring soot physicochemical properties formation mechanics

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