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上吸式气化炉木屑气化结渣特性

Slagging characteristics of sawdust gasification in updraft gasifier

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中文摘要:

为了探索上吸式气化炉内木屑气化结渣形成的原因与机理，在自制的上吸式生物质气化炉上通过控制气化条件形成结渣，分析了结渣形成的工况与部位，并对渣样进行了详细的表征。结果表明：随着入炉空气量的增加，气化炉内氧化区的温度急剧增加，气化强度显著增大，当入炉空气量超过3.5 m3/h时，气化强度高达112.7 kg/(m2·h)，氧化区温度大于1?129℃，气化炉内极易结渣。上吸式气化炉结渣主要发生在底部氧化区，属超温结渣，生物质灰熔融黏结，在停炉过程中降温凝结而成；渣样呈块状、灰黑色，含碳量非常低，质地坚硬，结构致密，高温熔融降温凝结使得渣样内部孔隙坍塌、表面孔闭塞，比表面积和孔容积均非常低；高温结渣过程中低熔点易挥发的元素如碱金属（K）、碱土金属（Mg、Ca）、P、S等的含量下降，而高熔点难挥发的元素如Al、Si等不断富集；与马弗炉在550℃和815℃制得的生物质灰相比，高温熔融使得晶型改变，在渣样中除了SiO2外，还形成了大量硅酸盐形式的共晶体，包括Ca(Mg,Al,Fe)Si2O6、CaMg(SiO3)2、KAlSi3O8、K(Si3Al)O8、Ca(Fe, Mg)(SiO3)2等

英文摘要:

To discuss the mechanism of sawdust slagging, slag was formed by controlling gasification conditions on a self-made updraft biomass gasifier, the slagging condition and location were analyzed, and slag samples were also characterized in detail. The results showed that, as air flow rate increasing, the oxidation temperature of the gasifier increased sharply, and the gasification intensity enhanced obviously. As air flow rate exceeded to 3.5 m3/h, the gasification intensity was higher than 112.7 kg/(m2·h), and the oxidation temperature was up to 1?129℃, thus slagging was easy to generate inside the gasifier. The slagging in the updraft gasifier belongs to over-temperature slagging, and it was mainly formed in the oxidation zone at the bottom of the gasifier by the biomass ash melted and bonded, and finally condensed in the cooling process after shutdown the gasifier. The slag sample appeared block shape and gray-black color, with very low carbon content, hard texture and compact structure. High-temperature melting and cooling condensation caused its internal pore structure collapse and the surface pore occlusion, the specific surface area and pore volume were both very low. During the high temperature slagging process, the content of the low melting point and highly volatile elements such as alkali metal (K), alkaline earth metal (Mg, Ca), P, S, etc. decreased, while the high melting point and difficult volatile elements such as Al, Si, etc. were enriched. Compare with the biomass ash prepared at 550 and 815℃, high temperature melting changed the crystal form, and besides SiO2, much silicate eutectic was also formed in the slag samples including Ca(Mg, Al, Fe)Si2O6, CaMg(SiO3)2, KAlSi3O8, K(Si3Al)O8 and Ca(Fe, Mg)(SiO3)2, etc.

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