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## 滚扎甩碎组合式香蕉茎秆纤维提取机设计与试验

### Design and experiment on rolling and crushing combined extracting machine for banana stem fiber

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中文摘要:

香蕉茎秆中含有丰富的植物纤维,其机械提取具有效率高、污染少等优点,是一项具有发展潜力的香蕉茎秆机械化处理技术。目前,由于香蕉茎秆粗大、含水率高等问题,机械提取香蕉茎秆纤维成熟技术较少。针对上述问题,该文研制了滚扎甩碎组合式香蕉茎秆纤维提取机,该机主要由传动系统、I级滚扎装置、II级滚扎装置、甩碎装置、电机等部分构成。样机性能试验表明:该机香蕉茎秆纤维提取率为89.2%,含杂率为8.6%,生产率为206 kg/h,能耗为20.2 kW·h/100 kg,符合设计要求。与半喂入式香蕉茎秆纤维提取机相比,该机的提取率提高了8.1%,含杂率降低了6.5%,生产率提高了71.7%,能耗降低了10.6%。该研究可为香蕉茎秆纤维提取机设计提供参考,对促进中国热带农业区香蕉产业发展具有重要的意义。

英文摘要:

Abstract: Banana stalk is the main byproduct of bananas after post-harvest, and is mainly decayed naturally or discarded in the field, due to large stalk, high moisture content and other characteristics, resulting in a great waste of resources and an environmental pollution problem. Meanwhile, banana stalk contains high-quality plant fiber, which is lightweight, with strong permeability, also has high economic value, which is suitable for the production of medium and top-grade products, such as suits, shirts, ties, and various decorations, as well as fine paper. So far, the domestic and foreign research on fiber extraction and application mostly concentrates in rice straw, corn stalk, cotton stalk, biogases, or pineapple leaf, etc. Drawing on the previous studies, water immersion method, biochemical and mechanical extraction method and other methods are available, but just the immersion method and the biochemical method are mainly adopted by researchers. Domestic mechanical extraction of banana stalk fiber is still in its infancy, due to its regional characteristics, particularly for fiber extraction machinery, which is rarely reported both at home and abroad. Based on the above issues, a banana fiber extracting machine with a hybrid of rolling and smashing was put forward and designed in this paper, which was mainly composed of a conveying device, rolling device, rolling device II, smashing device, machine cover, walking wheel, drainage pipe, motor, and machine chassis. During the working period, banana stalk was conveyed to a rolling device I via conveyor belt, and crushed first through the relative rotation of the upper roller and lower roller (distance between two rollers of 5-10 cm). Then, it was conveyed to rolling device II, and was crushed secondly through the relative rotation of the upper roller and lower roller (distance between two rollers of 2-5 cm). After the above two steps, more than 80% of water was extruded, and was discharged through the drainage device. Then, the crushed banana stalk was smashed by high-speed knives in the smashing device. Finally, the processed banana fiber was discharged through the lower bezel. Referring to the current situation, the paper designed the rolling and crushing combined type extracting machine for banana stem fiber. It gave the main structure of some components including drive system, rolling device I, rolling device II, crushing device and motor, and simulated the crushing knife by finite element analysis. The sample test results showed as below: the passing rate of fiber rubbing objects was 89.2%, the impurity rate was 8.6%, the output was 206 kg/h, and the energy consumption was 20.2 kW·h/100kg. The research indicates that the design meets the requirements. Compared with the half feeding type extracting machine for banana stem fiber, the rolling and crushing combined type extracting machine for banana stem fiber improved the passing rate of fiber rubbing objects by 8.1%, decreased the impurity rate by 6.5%, improved the output by 71.7%, and decreased the energy consumption by 10.6%. Successful implementation of this project will lay a solid theoretical design of high performance to adapt to the field of banana stalk fiber extraction machines, and will have important practical significance to promote the sustainable development of the tropical agricultural areas in China.

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