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粉煤灰资源化利用案例研究与评价

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硕士学位论文

粉煤灰资源化利用评价与案例研究

Evaluation and Case Study on the Comprehensive

Utilization of Fly Ash

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摘要

粉煤灰是煤粉燃烧后，随锅炉烟气排放的细灰状残留物，是煤炭燃烧的副产品。随着煤炭的广泛应用，世界各国的粉煤灰排放量都呈逐年增加的趋势，粉煤灰的综合利用率成为亟需解决的重要问题。粉煤灰的大量堆放，不仅占用了宝贵的土地资源，而且对环境和人类的健康带来了直接或间接的威胁和危害。粉煤灰曾长期被视为固体废弃物而未得到很好的利用，浪费和污染现象严重。随着社会的发展，越来越多的研究和实践证明粉煤灰可作为一种替代资源加以循环利用，在资源日益匮乏的今天，粉煤灰逐渐引起了关注。对粉煤灰进行资源化利用，以达到变废为宝，化害为利，成为当今的研究热点之一。基于我国粉煤灰的资源化利用还存在着诸多的问题，如粉煤灰综合利用率 and 利用水平不高，粉煤灰利用缺少稳定的途径，粉煤灰利用存在着二次污染的问题等，我们必须对粉煤灰资源化利用进行科学、系统和客观地评价和研究，积极引导、促进粉煤灰的资源化利用，推动资源节约型社会的发展，促进社会经济和资源环境的可持续发展。

结合厦门嵩能粉煤灰开发有限公司的粉煤灰资源化利用的实际情况，本文对其粉煤灰资源化利用带来的效益和存在的问题进行了综合评价，通过构建粉煤灰资源化利用评价指标体系，分析了粉煤灰资源化利用在经济效益、社会效益、环境效益、政策、管理、技术等方面的指标。对每个定性和定量指标进行了深入的研究，界定了指标的作用、含义、计算方法和评价标准。依据数据的易获取、可操作、客观真实的原则，在经济效益指标、技术指标方面设置了大量的定量指标和计算公式，在社会效益、环境效益、政策、管理指标评价方面较多的使用了定性指标，提高了指标体系的实用性和客观性。本文在构建的评价指标体系基础上，采用综合评价方法对嵩能公司进行评价，具体分析实现了粉煤灰资源化利用评价的方法和途径，对指标体系各部分及其之间的关系进行了分析论述，使指标体系的设置较为全面合理。在综合考虑指标的特点、数据的可得性方面分别运用层次分析法、目标定位比较法、专家评分、德尔斐等方法确定评价因子的综合权重，根据各个指标的权重值，使用加权平均法计算厦门嵩能粉煤灰开发有限公司的粉煤灰资源化利用综合评价值，嵩能公司最终得分为 68.4 分，该公司被评价为第三等级的粉煤灰资源化利用企业。通过分析评估结果和原因，建议嵩能公司改进

清洁生产审计以及 ISO9001, ISO14001 认证工作所要求的相关生产管理细节, 加强对自身职工进行环保相关教育工作, 另外还要完善综合管理, 健全管理体制和政策。为了拓宽嵩能公司的粉煤灰资源化利用途径, 提高粉煤灰资源化水平, 增加产品附加值, 建议嵩能公司加强粉煤灰的深加工项目的开发, 如应用于环保领域的废水治理, 注重提高粉煤灰利用的社会效益, 提高粉煤灰综合利用率。

本文从推动厦门嵩能公司粉煤灰资源化利用的角度入手, 以可持续发展、循环经济、清洁生产等基本理论为基础, 围绕国内外粉煤灰综合利用情况进行分析, 并通过实验研究了粉煤灰吸附废水中的铜离子。在实验研究中, 从 pH、温度、初始铜离子浓度、粉煤灰投加量、粒径、振荡时间等不同角度初步分析了粉煤灰去除废水中铜离子的效果, 并对各影响因素进行了进一步的理论解释。通过实验研究结果, 得出粉煤灰可以作为一种有效、廉价的吸附剂用于污水治理领域, 从技术角度上初步验证了其在废水治理领域应用的可行性。由于嵩能公司的粉煤灰粒度小, 建议嵩能公司今后开展粉煤灰处理含铜废水的研究和应用, 在进行这方面的研究与应用时, 综合考虑经济、吸附效果等因素, 将铜离子的吸附平衡时间定为 1 h; 灰水比设为 3 g/100 mL; 废水的 pH 值调至 6 左右; 温度控制在室温条件下吸附低浓度含铜废水。目前国内外对粉煤灰处理城市污水的研究已经进入应用阶段, 为粉煤灰在该领域的利用奠定了基础。厦门嵩能公司的粉煤灰利用水平不高, 利用途径单一粗放, 为拓展嵩能公司粉煤灰的应用领域, 尤其是在治理废水中的应用提供参考依据, 促进嵩能公司进一步提高粉煤灰资源化利用水平和延长生产链。

关键词: 粉煤灰; 资源化利用; 评价; 指标; 铜

Abstract

Fly ash, a byproduct of coal combustion, is a dust residue discharged with boiler flue gas when burning coal. With the wide use of coal, there is an increasing trend of fly ash emissions all over the world. However, comprehensive utilization of fly ash becomes a pressing problem. Piling up fly ash not only occupies valuable land but also harms human health and environment directly or indirectly. Perceived as solid waste for a long time, fly ash has not been utilized rightly and leads to severe environmental pollution. With the development of society, more and more research and practice indicate fly ash is a kind of alternate resource to reuse. Comprehensive utilization of fly ash can turn the “Waste” into Wealth and change the harm into benefit, which make it one of research hotspots at present. There exist many problems in the comprehensive utilization of fly ash in China, such as low utilization ratio and level, unstable utilization approaches, second pollution et. al. In this case, we should carry out scientific, systematical, objective evaluation and studies on the comprehensive use of fly ash in order to actively guide and promote its utilization, and to stimulate the development of resource-saving society, as well as to facilitate the sustainable development of society, economy, resource and environment.

Based on the comprehensive utilization of fly ash in Xiamen Songneng Fly Ash Dvelopment Co, Ltd, in this thesis, benefits and problems from comprehensive utilization of fly ash in this company are evaluated systemically. Indices of economic benefit, social benefit, environmental benefit, management, policy as well as technology are analyzed by establishing evaluation index system of comprehensive utilization of fly ash. Function, meaning, calculation method and evaluation standard of qualitative and quantitative indices are defined. Based on the acquisition, operation and objectivity of data, a large number of quantitative indices and calculation formulas are set in the economic benefit and technological benefit indices. Qualitative indices are used in the social benefit, environmental benefit, policy, management indices. All those improve the practicability and objectivity of the index system. In this thesis, evaluation of comprehensive utilization of fly ash in the Songyu Co, Ltd.is made by integrated evaluation methods based on the established evaluation index system. Methods and approaches for completing the evaluation of comprehensive

utilization of fly ash are concretely analyzed theoretically. Relationship among indices is discussed to make indices system comprehensive and reasonable. According to characteristic of indices and acquisition of data, weights of evaluation factors and final evaluation values of indices are identified by the combination methods of Analytic Hierarchy Processing, Objective Oriented Comparison, Expert Grading, and Delphi. According to various index weights, integrated evaluation value of comprehensive utilization of fly ash in the company is calculated using weighted average method. The final score of Songneng Co, Ltd is 68.4. The company is evaluated as the third grade enterprise of comprehensive utilization of fly ash. Advices that Songneng Company should improve production management required by Cleaner Production Audit, ISO9001 Certification, and ISO14001 Certification are mentioned by analyzing evaluation result and reasons. Environmental protection education should be strengthened for workers. In addition, integrated management should be facilitated and management system and policy should be amplified. For the purpose of broadening the utilization channels of fly ash, improving the comprehensive utilization of fly ash as well as enhancing the product added value, the company should promote the development of deep processing projects of fly ash, such as the application in the wastewater treatment in environmental protection field, emphasize the increase of social benefit from utilization of fly ash and comprehensive utilization ratio of fly ash.

In this thesis, from the perspective of promoting the comprehensive utilization of fly ash in the Xiamen Songneng Co, Ltd, worldwide situation of comprehensive utilization of fly ash is analyzed and experimental studies on the adsorption of copper in the wastewater using fly ash are carried out based on theoretical foundation of sustainable development, circular economy and cleaning production. In the experimental study, effects on the removal of copper in the wastewater by fly ash are analyzed under different factors of pH, temperature, original copper concentration, granularity, fly ash dose and time. Further theoretical explanation on various influence factors is presented. From the results of experimental study, we conclude fly ash can be used as a cheap, high efficiency adsorbent in wastewater treatment and initially validate the technological feasibility of utilization of fly ash in the wastewater treatment field. Concrete advices of future development on further prolonging production chains in the Xiamen Songneng Fly Ash Development Co, Ltd. are

provided. Based on the little fly ash fineness of the company, when the company begin research and utilization of fly ash in the treatment of copper wastewater, under the consideration of economical factor and adsorption effect, adsorption equilibrium time should be set 5 hours; proportion of water to fly ash should be set 3 g/100 mL; pH of wastewater should be adjusted to around 6; treatment of low concentration copper wastewater should be done under the room temperature. At present, worldwide research on municipal wastewater treatment using fly ash has turned to be applied in practice, which paves a solid way for the utilization of fly ash in the field. Level of fly ash utilization in Xiamen Songneng Co, Ltd. is not high relatively and utilization ways are single and extensive. The research provides reference for expanding application fields of fly ash in the company especially in the field of wastewater treatment. It can also promote the comprehensive utilization level of fly ash and prolongs production chain.

Keywords: fly ash; comprehensive utilization; evaluation; index; copper

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