CHINA`S EXPERIENCE IN DUST CONTROL: A LEGAL MODEL FOR ENVIRONMENTAL PROTECTION

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ANNOTATION

This study focuses on construction dust emissions generated during construction activities and examines their impact on the environment, human health, and sustainable development. Construction activities such as excavation, drilling, transportation of bulk materials, loading and unloading, open-air storage, concrete and mortar production, cutting and filling operations, and the movement of construction equipment can generate significant amounts of dust emissions into the atmosphere. Construction dust represents a potential threat not only to workers at construction sites but also to local communities and the surrounding environment.

The study analyses China's experience in controlling construction dust emissions from legal and institutional perspectives. Particular attention is given to environmental legislation, government regulation and supervision, the implementation of modern dust-control technologies, and the accountability of construction organizations and other participants in the construction process. The findings demonstrate that effective construction dust control cannot be achieved through isolated technical measures alone. Instead, it requires an integrated approach combining legal, economic, technological, organizational, supervisory, and assessment-based mechanisms. China's experience demonstrates how legally binding standards, enforcement mechanisms, technological innovation, and institutional accountability can contribute to more effective environmental governance in the construction sector. The identified approaches may also provide useful practical insights for other countries facing similar challenges related to construction dust pollution and sustainable construction.

Keywords: construction dust, dust emissions, environmental protection, environmental safety, environmental legislation, government regulation, construction industry, sustainable development, technological innovation, environmental governance, China's experience.

ОПЫТ КИТАЯ В КОНТРОЛЕ ЗАПЫЛЕННОСТИ: ПРАВОВАЯ МОДЕЛЬ ОХРАНЫ ОКРУЖАЮЩЕЙ СРЕДЫ

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АННОТАЦИЯ

Данное исследование посвящено изучению выбросов строительной пыли, возникающих в процессе строительной деятельности, и их воздействия на окружающую среду, здоровье человека и устойчивое развитие. Строительные работы, включая земляные работы, бурение, транспортировку, погрузку и разгрузку строительных материалов, их хранение на открытых площадках, производство бетона и строительных растворов, а также перемещение строительной техники, являются источниками значительных выбросов пыли в атмосферу. Строительная пыль может негативно воздействовать не только на работников строительных площадок, но и на население прилегающих территорий и окружающую природную среду.

В исследовании рассматривается опыт Китая в области контроля выбросов строительной пыли с точки зрения правового и институционального регулирования. Анализируются

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экологические нормы и требования, разработанные государственными органами, механизмы государственного контроля за деятельностью строительных организаций, применение современных технологий для снижения выбросов, а также вопросы ответственности участников строительного процесса. Результаты исследования показывают, что эффективный контроль строительной пыли не может основываться исключительно на отдельных технических мерах. Он требует комплексного подхода, включающего правовые, экономические, технологические, организационные и надзорные инструменты. Опыт Китая может быть использован в качестве практического ориентира для других стран, стремящихся совершенствовать экологическое управление и механизмы контроля загрязнения в строительной отрасли.

Ключевые слова: строительная пыль, выбросы пыли, охрана окружающей среды, экологическая безопасность, экологическое законодательство, государственный контроль, строительная отрасль, устойчивое развитие, технологические инновации, экологическое управление, опыт Китая.

XITOYNING CHANGNI NAZORAT QILISH TAJRIBASI: ATROF-MUHITNI MUHOFAZA QILISHNING HUQUQIY MODELI

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ANNOTATSIYA

Mazkur tadqiqot qurilish faoliyati jarayonida yuzaga keladigan chang emissiyasining atrof-muhit, inson salomatligi va barqaror rivojlanishga ta’sirini o‘rganishga bag‘ishlangan. Qurilish ishlari, jumladan, qazish, burg‘ilash, materiallarni tashish, yuklash va tushirish, ochiq maydonlarda materiallarni saqlash, beton va qorishma tayyorlash hamda qurilish texnikalarining harakatlanishi natijasida atmosferaga katta miqdorda chang zarrachalari chiqarilishi mumkin. Ushbu holat nafaqat qurilish maydonlaridagi ishchilarga, balki atrofdagi aholi va ekologik muhitga ham salbiy ta’sir ko‘rsatadi.

Tadqiqotda Xitoyning qurilish changi emissiyasini nazorat qilish bo‘yicha tajribasi huquqiy va institutsional nuqtayi nazardan tahlil qilinadi. Xususan, davlat tomonidan ishlab chiqilgan ekologik me’yorlar, qurilish tashkilotlari faoliyatini nazorat qilish mexanizmlari, changni kamaytirishga qaratilgan zamonaviy texnologiyalar hamda qurilish kompaniyalarining javobgarligi ko‘rib chiqiladi. Tadqiqot natijalari chang emissiyasini samarali kamaytirish faqat alohida texnik choralar bilan cheklanib qolmasligi, balki huquqiy, iqtisodiy, tashkiliy, texnologik va nazorat mexanizmlarining o‘zaro uyg‘unligini talab qilishini ko‘rsatadi. Xitoy tajribasi boshqa mamlakatlarda ham qurilish sohasida ekologik boshqaruvni takomillashtirish uchun amaliy asos sifatida xizmat qilishi mumkin.

Kalit so‘zlar: qurilish changi, chang emissiyasi, atrof-muhit muhofazasi, ekologik xavfsizlik, ekologik qonunchilik, davlat nazorati, qurilish sohasi, barqaror rivojlanish, texnologik innovatsiyalar, ekologik boshqaruv, Xitoy tajribasi.

Introduction

The construction industry is often criticized for being one of the heavy polluters that generate dust to the atmosphere from construction works. Construction dust emission (CDE) originates from many types of onsite activities such as excavation, drilling, bulk material transportation, loading and unloading, open-air material storage, concrete and mortar making, cutting and filling, and the

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movement of equipment[1]. These activities release the calcium element of PM2.5, which is a component of construction dust and an environmental pollutant[2]. In effect, construction dust forms a nuisance to site workers and has adverse off-site impacts on local communities. The existence of construction dust in the human lung can result in diseases such as silicosis, bronchitis, the obstruction of trachea, and occupational asthma[3]. In China, for instance, the human health damages caused by construction dust pollution account for 27% of the total impacts of construction projects on the natural environment[4]. Similar situations are appreciated in other countries such as the European Union, Great Britain, and the United States[5]. It is thus reasonable to predict that construction dust pollution will be an acute environmental crisis in the future if it is not under control.

Construction dust is released in various locations, to varying extents, and with different durations and frequencies. Finding an effective way to control CDE is subject to obstacles. One of the major obstacles is an increase in construction cost, which contractors have to handle ultimately. Indeed, both the clients and contractors may not accept those construction projects that have the problem of cost overrun. In addition, voluntary control over the construction dust emission of contractors often reaches an environmental cartel agreement among themselves, which is unfavorable to the sustainability of the construction industry[6]. Recommended that governments account for two categories of dust control regulations: environmental protection-related and construction-related. To underpin the formulation of governmental measures, sources of CDE, measures to inhibit CDE, and the utilization of CDE technologies have often been discussed in previous studies[7]. While the existing measures complement each other, few of them portray a whole picture of measures that governments can implement in a direct way. Instead, the measures adopted by a government are unsustainable or are not effective enough to inspire contractors to implement dust-free construction. As described in the following section, China's governments across various levels have accumulated rich experiences in handling this matter, which sheds some lights on the practices in other countries. Therefore, the aim of this study is to map out what governments can do in response to contractors' dust emissions in the Architecture, Engineering and Construction (AEC) industry by taking China as a case. The central research question guiding this study is:

- how has China's legal framework contributed to effective dust control in environmental protection?

By addressing this question, the paper aims to demonstrate that China's progress in reducing dust pollution is not merely the result of technological advancement or economic restructuring, but largely the outcome of a deliberate shift toward legally driven environmental governance[8].The analysis focuses on the evolution of environmental legislation, the mechanisms of legal enforcement, the integration of economic and technological tools, and the role of accountability in ensuring compliance.

Legal framework

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In China, an ambitious program for urbanization was launched by the Central Government in the 1980s[9]. Recent years have witnessed the rapid change of urbanization in China. Nevertheless, the progress of urbanization nationwide has been associated with the outspread distribution of dust pollution[10]. Many regions have encountered an increase in environmental deterioration due to an unsustainable paradigm of construction works. According to the Report on the State of the Environment (2009–2012), although particulate pollution in China has reduced to a lower level, over 85% of 74 major cities still have a PM10 concentration higher than the baseline specified in the Ambient Air Quality Standard. For instance, in Beijing, the average monthly contribution of construction dust to the overall PM10 pollution was around 10%[11]. Dust emissions in some places of Shanghai accounted for 12.4% of air particles[12]. In Guiyang, which is supposed to be an ecological city in Southwest China, the proportion is surprisingly 24.89% as measured by fugitive dust[13].

Many attempts have been made by China's governments to control CDE in the industry. The Guideline of Green Construction issued by the central government specifies areas that are suitable to apply technologies to mitigate dust pollution. The advent of modern technology facilities enables contractors to sustain flexibility in selecting advanced measures to mitigate construction dust pollution. Typically, construction site enclosure, road pavement, materials covering, water cleaning, tight transportation, and tree planting are extensively adopted on construction sites. These measures vary significantly in nature, but they are widely valued in protecting the natural environment and enabling the efficient use of production factors (e.g., materials, water, energy, and land). By far, over 80% of construction sites utilize technological means to control CDE in Suizhou city of Hubei province[14]. The extensive usage of technologies allows 95% of construction vehicles to have minor impacts on Linyi city of Shandong province[15]. Interestingly, notwithstanding the improvement of CDE control, the majority of Chinese contractors has a weak willingness to input more resources for this practice.

As discussed above, governments at this time ought to undertake the obligation of formulating preventative measures. The Law on Prevention and Control of Atmospheric Pollution[16] promulgated by the central government outlines a dust-free commitment in paragraph 2 of article 43. According to this law, the construction sector should be under strict supervision, and the role of local governments in this matter is to formulate standards and specifications. In Beijing, the local government enforced the Regulation on Prevention of Construction Dust Emission on Construction Sites[17], which requires property developers to engage contractors to mitigate dust emissions, especially in demolition and removal projects[18]. In addition, participants in the construction process are advocated to take collective actions in the attainment of zero-dust construction, and residents will be rewarded with some bonuses if their reporting of construction dust pollution is confirmed. To summarize, cities in China have

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accumulated considerable experiences in coping with construction dust pollution. The rich experiences might be useful for other developing countries to consider to improve their practice.

Analysis sections

Whilst governments are highly expected to get involved in the control of construction dust emission, little has been informed about why governments shall take part in, and how government can do better. According to the Agenda 21 for Sustainable Construction in Developing Countries[19], governments act as an agent for public interests in the attainment of sustainable development. One of the most effective ways for them is by virtue of institutional arrangements, which could be either social or environmental. In the area of construction dust, institutional arrangements refer to the supervising behaviors of individuals and organizations, providing institutional guarantees, and stimulating technological innovation. The key to these institutional arrangements is embracing a holistic approach to restoring and maintaining harmony between the natural and built environment[20]. However, this is far beyond the capability of a construction firm, and the institutional arrangements will be ineffective if contractors are not highly motivated. Hence, it is crucial that governmental measures are able to enhance contractors' recognition, awareness, attitudes, and performance in the implementation of construction dust control. Different governments have different stances on the choices of policies to decrease CDE[21]. Quite often, they formulate and promote policies that are in line with their ideological preferences. The stringency of formulating environmental standards varies across geographical regions, and with the severity of environmental issues and the environmental awareness of stakeholders. Therefore, local governments in developed regions may enforce environmental regulations more actively, while less developed regions may prioritize economic development and have weaker enthusiasm for implementing environmental policies[22]. In addition, population growth urges governments to devise and implement stricter environmental regulations. Furthermore, institutional inefficiency would prevent governments from implementing environmental policy measures as well. As pointed out by Vowles[23], those institutions with strong power and authority have a better position from which to develop and enact policies to reduce environmental pollution. Institutional guarantees for social undertakings are concerned with some widely accepted rules and regulations. The United Kingdom (UK) implemented a regulation called Raising the Bar 18: Control of Dust, in which contractors are required to satisfy minimum requirements to remove health threats and environmental nuisance from activities that produce dust[24]. Employers in developed countries are recommended to follow a protocol that includes plans, organization, control, monitoring, review, respiratory personal equipment, and a fit test. Similarly, governments in developing countries might use legislation systems to inhibit contractors from dust emissions in construction projects. It seems to be that measures for local governments to mitigate CDE can be taxation, subsidization, regulations, education, training, and guidance.

Construction dust emissions are all-pervading environmental pollutants that have drawn closer attention from many cities around the world. Yakima, a United States (US) city, lists all of the possible dust emission challenges in its Construction Dust Control Policy of the Yakima Regional Clean Air Agency[25], and requires agencies and non-profit social organizations to address any of the challenges

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that lie ahead. Occupational Safety and Health Administration in the US includes some permissible exposure limits to dust that contains crystalline silica[26]. The Control of Substances Hazardous to Health Regulations[27] requires employers in the construction sector to immunize their employees and the surrounding area from hazardous substances. The effectiveness of dust control measures is partly determined by using a well-developed technological system in which governments are the supporters of technical innovation and application. In appraising 11 emission processes (e.g., open-air storage and transportation) and 11 businesses that produce fugitive dust (e.g., the manufacturing and processing industries of cement, lime, plaster, and cement-related products, and the construction industry), the Seoul Metropolitan Government established installation standards for facilities and measures to control fugitive dust[28]. The Aylesbury Vale District Council[29] requires contractors to build an intelligent storage yard sprinkling system to track dust concentration in the atmosphere, as well as its velocity, wind direction, temperature, and humidity. The monitor sends signals to the control system to determine when to sprinkle and at what speed. In addition, technical approaches to reducing dust exposure include an exhaust ventilation system, wet dust suppression, and personal protective toolkits (e.g., reusable respirators)[30]. Technologies of these kinds are largely created by contractors. However, the creation is characterized by uncertainty and much financial burdening, which can in turn hinder contractors from applying technologies. In reverse, contractors would be more willing to replace the dry sweeping system with a central vacuum if they receive either the technical or financial support of governments[31].

Discussion

In China, governments bear the responsibility of overseeing contractors to improve environmental performance in construction projects. Shepherd and Woskie[32] revealed that drilling, sawing, chipping, and grinding concrete in the construction industry generate inhalable crystalline silica, which is a serious hazard for on-site workers. Governments' response to this issue is to prohibit field concrete and mortar. Media can be used to publicize contractors who violate the rules. In effect, it plays an important role in supervising and inspecting contractors to comply with regulations. Both interview and field study indicate that field concrete and mortar is frequently used and becomes part of ordinary work processes. It was found that contractors are requested to apply local exhaust ventilation (LEV) to decrease construction dust emissions. Nonetheless, LEV has some limited applications on construction sites, and it has attracted less attention from television, radio, newspapers, and magazines. The interviews also reveal that this measure has not widely been applied due to cost and labor-intensive attributes. A similar situation exists for requiring respiratory protection. Respiratory protection is an effective way to reduce exposure, and it has been widely used in developed countries (e.g., the United States, Australia). Some provincial governments in China require respiratory protection on construction sites, and the media is expected to advertise the importance and benefits of respiratory protection. However, its application is not so extensive in the construction sector. According to the interviewees, this is because that the protection tool disturbs workers' job on sites.

In fact, recent years have witnessed an expansion of governmental interests in this measure worldwide. For instance, the National Green Tribunal of India requires contractors to pay a fee to compensate for environmental pollution in accordance with their building plot sizes, according to the

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Hindustan Times[33]. The Hawaii government announced that stakeholders should pay dust control costs using a lump-sum price, as defined in contracts[34].

Conclusion

Severe environmental pollution caused by construction dust emissions has compelled governments, particularly in China, to reassess their strategies for achieving sustainable development. This study demonstrates that construction dust control cannot be effectively addressed through isolated actions; instead, it requires a comprehensive and integrated approach. China's experience shows that dust control measures can be systematically categorized into five interrelated dimensions: technological, economic, organizational, supervisory, and assessment-based measures. Together, these components form a structured framework that supports more effective environmental governance in the construction sector.

In response to the research question the findings indicate that China's legal framework has played a crucial role by institutionalizing dust control requirements, mandating the adoption of dust-reduction technologies, strengthening organizational accountability, and enhancing regulatory supervision. Through legally binding standards, enforcement mechanisms, and performance evaluations, the government has been able to guide contractors toward more sustainable construction practices and significantly reduce construction dust emissions. Based on the findings of this study, the following recommendations are proposed:

- **Strengthening legal and regulatory enforcement mechanisms.**

Governments should enhance the enforcement capacity of environmental laws related to construction dust control, ensuring strict compliance through regular inspections, penalties, and accountability systems;

- **Promoting technological innovation in dust control.** Public authorities should actively support the development and application of advanced dust-suppression technologies by providing financial incentives, subsidies, and policy support to contractors;

- **Improving organizational and institutional arrangements.** Clear allocation of responsibilities among government agencies, contractors, and supervisory bodies is essential to ensure coordinated implementation of dust control measures across all construction stages;

- **Enhancing monitoring and assessment systems.** Governments should establish robust evaluation frameworks to continuously assess the effectiveness of dust control measures and adjust policies based on empirical performance data;

Although this research is based on China's experience, the findings offer valuable insights for other countries facing similar challenges related to construction dust pollution. The conceptual framework and policy tendencies identified in this study can serve as practical references for improving dust control governance globally. Future research is recommended to further investigate the underlying rationale behind governmental decision-making processes in selecting specific dust control measures and to empirically evaluate their long-term effectiveness.

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