

# Control of Chemical Contamination in Food Engineering

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**Abstract:** With the rapid development of the food industry, chemical pollution has gradually become a prominent issue, posing a significant challenge in the field of food engineering. This paper explores the main sources of chemical contamination in food engineering and its impact on food safety, and proposes targeted control measures. By strengthening the formulation and enforcement of laws and regulations, promoting green agriculture and environmentally friendly production technologies, optimizing the use and management of food additives, and enhancing the environmental protection and safety of packaging materials, chemical pollution in food engineering can be effectively controlled to ensure food safety and public health. The implementation of these measures not only contributes to the sustainable development of the food industry but also enhances consumer confidence in food safety.

**Keywords:** food engineering; chemical pollution; control

## Introduction

In food engineering, chemical pollution has become an issue that cannot be ignored. Its sources are extensive, including but not limited to pesticide residues, industrial pollutants, food additives, and packaging materials. These pollutants may have serious impacts on the safety and quality of food, thereby threatening human health and the environmental ecosystem. Therefore, effective control of chemical pollution in food engineering is crucial. This paper aims to explore the main sources and impacts of chemical pollution in food engineering, and propose corresponding control measures to provide strong

guarantees for the sustainable development of the food industry and food safety.

## 1. The Main Sources of Chemical Pollution in Food Engineering

Chemical pollution is a significant issue in food engineering, arising from various sources including pesticide residues, industrial pollutants, food additives, and packaging materials. These sources have serious implications for the safety, quality, and taste of food, thereby posing a threat to human health and the environment. (1). Pesticide residues are a common form of chemical pollution in food. The widespread use of pesticides, while enhancing crop yields, has led to



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residues remaining on or within agricultural products, subsequently entering the food supply chain. These pesticide residues may pose long-term health hazards to humans, such as carcinogenicity, teratogenicity, and mutagenicity. Therefore, controlling pesticide residues is a crucial aspect of chemical pollution control in food engineering.(2). Industrial pollutants are also significant sources of chemical pollution in food engineering. The discharge of wastewater, emissions, and waste materials during industrial production processes, if not properly treated, can contaminate water sources, soil, and air, thus polluting agricultural products and food. These industrial pollutants may contain harmful substances such as heavy metals and organic pollutants, which can cause irreversible harm to human health through long-term ingestion.(3). Improper use of food additives may also contribute to chemical pollution in food engineering. Food additives, as essential means of enhancing food quality and taste, play a vital role in improving food quality and meeting consumer demands. However, excessive use or improper application of additives may lead to chemical substances exceeding safe limits in food, posing potential threats to human health. Therefore, regulating the use and management of food additives is a crucial step in ensuring food safety.(4). Packaging materials are another significant source of chemical pollution in food engineering. Some packaging materials may contain toxic and harmful chemicals during their production process. These substances may enter food through permeation or volatilization, causing food contamination. Additionally, some packaging materials may release gases such as oxygen and ethylene during use, leading to issues such as food oxidation and spoilage. Therefore, selecting environmentally friendly and safe packaging materials is essential in preventing chemical pollution in food engineering.

## **2. The Impact of Chemical Pollution on Food Safety in Food Engineering**

Food safety is a fundamental requirement in human life and a cornerstone of national development. However, with the acceleration of industrialization and widespread use of chemicals, chemical pollution has become a significant threat to food safety. In food engineering, chemical pollution has profound negative effects on food safety. Firstly, chemical pollution poses

direct health hazards to humans. Food is an essential source of nutrition in daily life, and once contaminated by chemical pollutants, harmful substances may enter the human body through the food chain. Long-term accumulation of these substances may lead to various health problems. For example, pesticide residues may cause chronic poisoning symptoms such as headaches, nausea, and vomiting. Heavy metal pollution may affect multiple aspects of the human body's nervous system, digestive system, and immune system, posing a severe threat to human health. Therefore, the direct health hazards of chemical pollution cannot be ignored. Secondly, chemical pollution has negative effects on the quality and taste of food. The quality and taste of food are critical factors determining consumer purchasing intentions. However, chemical pollution may lead to the loss of nutrients, changes in color and odor, and even the production of off-flavors and harmful substances in food, severely affecting the quality and taste of food. This not only harms consumers' interests but also affects the reputation and market competitiveness of the food industry. Thirdly, chemical pollution poses a threat to the sustainable development of the food industry. As an important pillar of the national economy, the sustainable development of the food industry is of great significance to the stable development of the economy and society. However, chemical pollution may result in the waste of food resources, increased production costs, and exacerbated environmental pollution, thereby constraining the sustainable development of the food industry. Moreover, chemical pollution may trigger food safety incidents, leading to a decrease in consumer trust in the food industry, which in turn affects market demand and competitiveness in the food industry.

## **3. Control Measures for Chemical Pollution in Food Engineering**

### **3.1 Strengthening the Formulation and Enforcement of Laws and Regulations**

Strengthening the formulation and enforcement of laws and regulations plays a crucial role in controlling chemical pollution in food engineering, serving as the cornerstone for ensuring food safety and public health. In the current food industry, the urgency of enhancing the formulation and enforcement of laws and regulations has become evident due to the recurring food safety issues caused by chemical pollution. (1).

Government Responsibility in Formulating Strict Food Safety Regulations: Governments must take on the responsibility of formulating stringent food safety regulations. These regulations should address the chemical pollution risks in various aspects of food production, processing, and distribution. It is essential to clearly prohibit or restrict the use of certain harmful chemicals. Specific regulations targeting pesticide residues, industrial pollutants, food additives, among others, should be established to ensure that the content of these substances in food remains within safe limits. Moreover, these regulations should be operational and enforceable, facilitating their implementation by regulatory authorities and food enterprises.(2). Enhanced Penalties for Violations: Increasing the severity of penalties for illegal activities is key to ensuring the effective implementation of regulations. Governments should establish strict penalty mechanisms to impose harsh penalties on enterprises and individuals that violate food safety regulations. This not only serves as a deterrent to prevent similar behaviors but also maintains fair competition in the market, protects the legitimate rights and interests of consumers. Additionally, a mechanism for public exposure of untrustworthy behavior should be established, causing offending enterprises to lose their foothold in the market competition.(3). Establishment of a Comprehensive Food Safety Supervision System: It is imperative to establish a comprehensive food safety supervision system covering various aspects of food production, processing, and distribution. This system ensures strict compliance with food safety standards. Regulatory authorities should strengthen routine supervision and spot checks of food enterprises to promptly identify and rectify any existing issues. Furthermore, it is essential to establish a robust mechanism for information sharing and collaboration to achieve coordinated supervision among different departments, thereby enhancing the efficiency of supervision. By implementing these measures, effective control of chemical pollution in food engineering can be achieved, contributing to the safeguarding of food safety and public health.

### **3.2 Promoting Green Agriculture and Environmentally Friendly Production Technologies**

The promotion of green agriculture and environmentally friendly production technologies plays

a pivotal role in controlling chemical pollution in food engineering. With the increasing awareness of food safety and environmental protection among the public, these environmental concepts and technologies are gradually receiving attention and being widely applied in practice. Green agriculture, as a new agricultural development model, emphasizes the importance of ecological agriculture and sustainable development. Its core lies in reducing the use of pesticides and chemical fertilizers to minimize chemical residues in agricultural products from the source. By employing methods such as biological control and organic fertilizers, green agriculture not only ensures the healthy growth of crops but also preserves the balance of the ecological environment. Consequently, the accumulation of harmful chemicals in agricultural products during the growth process is avoided, laying a solid foundation for food safety. Meanwhile, the role of environmentally friendly production technologies in the food processing process cannot be ignored. Traditional food processing methods often involve the generation and emission of hazardous substances, posing threats to food safety and exacerbating environmental pollution. Environmentally friendly production technologies, on the other hand, aim to reduce the generation of these harmful substances and improve resource utilization efficiency. For example, by improving processing techniques and adopting clean production technologies, significant reductions in the generation and emission of wastewater, exhaust gases, and waste residue can be achieved, thereby achieving greening of the food processing process. By promoting green agriculture and environmentally friendly production technologies, we can control chemical pollution in food engineering from both the source and the processing process, significantly reducing the risk of chemical pollution. This not only helps safeguard food safety and quality but also aligns with the principles of sustainable development. Moreover, these environmental concepts and technologies bring about numerous benefits, such as promoting the restoration and protection of agricultural ecosystems and enhancing the economic benefits and social reputation of food processing enterprises.

### **3.3 Optimizing the Use and Management of Food Additives**

Optimizing the use and management of food additives

is crucial for controlling chemical pollution in food engineering. As essential components of modern food industry, food additives play a significant role in improving food taste, appearance, and extending shelf life. However, improper use and management can lead to chemical pollution and pose potential risks to public health. When it comes to the use of food additives, strict adherence to the principles of "necessary, safe, and appropriate" is paramount. This means that additives should only be used when truly necessary and must consist of substances that have undergone safety assessments and proven to be harmless to human health. Additionally, the quantity of additives used should be controlled within reasonable limits to avoid health risks associated with overuse. This requires food production enterprises to strictly adhere to national standards during the production process to ensure the legal and compliant use of food additives. Furthermore, strengthening the supervision of food additives is equally important. The government should establish a comprehensive regulatory system to oversee the production, sale, and use of food additives, ensuring the safety and quality of additives sold in the market through regular inspections and stringent measures against illegal additives. Moreover, increasing penalties for violative enterprises serves as a deterrent and helps maintain fair competition in the food market. In addition to enhancing supervision, encouraging food enterprises to research and develop natural and healthy alternatives is also an important means of controlling chemical pollution. By developing new technologies and exploring new raw materials, food enterprises can produce safer and healthier food, reduce reliance on chemical additives, enhance food quality, and strengthen their core competitiveness, thus driving the sustainable development of the food industry.

### **3.4 Improving the Environmental Friendliness and Safety of Packaging Materials**

Enhancing the environmental friendliness and safety of packaging materials is a dual imperative to ensure food safety and environmental protection. As an indispensable component of food engineering, packaging materials unavoidably come into contact with food during the production process, thus their safety and environmental impact have direct and far-reaching effects on food quality. The safety of packaging materials cannot be overlooked. Traditional

packaging materials may contain various harmful chemicals such as heavy metals, plasticizers, and other potential hazardous substances, which may migrate into the food during packaging, posing potential risks to consumer health upon long-term consumption. Therefore, it is imperative to encourage the use of non-toxic and environmentally friendly materials to prevent harmful substances from entering food at the source. When selecting packaging materials, their environmental friendliness should be considered. Traditional plastic packaging materials may generate significant environmental pollution during production and use. Instead, the use of biodegradable and recyclable materials should be encouraged. These materials not only impose a smaller burden on the environment during use but can also be naturally degraded or recycled after disposal, significantly reducing environmental pollution. In addition to choosing appropriate packaging materials, strengthening the testing and supervision of packaging materials is also crucial. A comprehensive testing mechanism should be established to rigorously test packaging materials on the market to ensure compliance with relevant standards and regulations. Meanwhile, the government should enhance supervision of packaging material production enterprises, imposing severe penalties on those violating environmental and safety standards to maintain fair market competition and protect consumer rights. Furthermore, research institutions and enterprises should increase investment in research and development to drive innovation in packaging materials. Through the development of new technologies and materials, we can further improve the environmental friendliness and safety of packaging materials. For example, by improving production processes and developing new biodegradable materials, we can promote the green transformation of packaging materials and make greater contributions to food safety and environmental protection.

### **Conclusion**

With the continuous advancement of food engineering technology and increasing societal concern for food safety, controlling chemical pollution has become a key aspect of ensuring food quality and safety. Through the discussion in this article, we have recognized the severe threat of chemical pollution to food safety

and proposed a series of effective control measures. Looking ahead, we need to continue strengthening supervision and technological innovation, continuously improving the chemical pollution prevention and control system in food engineering, and providing the public with safer and healthier food. At the same time, we also hope for concerted efforts from all sectors to promote the green development of the food industry, making positive contributions to safeguarding food safety and human health.

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