The Chemicals Migration Research of Plastic Food Packaging

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Abstract. With the continuous improvement of quality of life, people also more and more high to the requirement of food packaging materials. Food safety problem has become the focus of global attention; food packaging safety is an important part of food safety. Plastic food packaging in contain some pollutants can migrate to which threatens the safety of consumers. Contamination in food packaging plastic pollution of food is determined by the ability of migration to food. In this paper, food plastic packaging materials of the chemical composition of the migration are studied.

Introduction

With the development of plastic industry, plastic is more and more widely used in food packaging. Plastic packaging materials and the relationship between foods, become the focus problem in the study of the packaging [1]. Polyvinyl chloride (PVC) is one of the earliest industrialization production of synthetic resin, used in food packaging is an important form of PVC film. PVC film is soft, flame retardant, insulation and low price etc, and has a very wide range of applications in food packaging, is often used in packing meat, fresh fruits and vegetables and cheese. Studies have found that some chemicals can remain in the plastic, and then migrated to the food, the introduction of food contamination, and the safety of the food hygiene [1]. Therefore, in-depth study and understanding of the migration behaviors of pollutants in food packaging to the food, for a better evaluation of food packaging hygiene safety is necessary.

The status quo of China's food plastic packaging

The development of China's food industry relative to the world in the rest of the developed countries are relatively backward, therefore in the mechanical equipment are a far cry from what the development of the field of food [1]. China experienced by traditional food packaging paper, tin cans, glass packaging, etc., it was in the process of plastic packing and composite materials. With the development and the progress of the society, this first all kinds of packaging material are also more and more. Such as organic synthetic plastics, food packaging has entered a new era.

Metal cans material reduction. With the development and progress of social economy, convenient has been the subject of people's life. Because the metal material itself cost higher, the quality of a material is relatively heavy, carrying more trouble, used in food packing and shipping cost is too high. In addition to less some food packaging needs. Such as: filling milk powder, canned meat and other special food [1]. The application of metal cans package materials also gradually replaced by other packing materials.

The development of plastic packaging materials. The development of China plastics packaging materials is considerable. After years of development, has initially formed efficiency, fairly technical level and scale of industry, occupies an important position in the packaging market, for the construction of the national economy played an indispensable role [2]. During the period of "11th five-year plan" remains "15th" during the pace of development, further development to the average rate of 15% a year, 2015, the annual output reached more than 1300, ten thousand tons, up 14% from 2014. Gross output value of 520 billion Yuan, packaging industry output value accounted for about 28%. Plastic packaging materials in one of the main products are plastic films, accounts for 55% of

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the total output of 12 million tons of plastic packing materials, the soft composite membrane about production accounts for nearly half plastic films again [2]. Flexible packaging film in the "15th" during the development of fast, this is mainly with the people's living standards improve and speed up the pace of life, the growing demand for the food and drinks milk packaging and demand of agricultural and sideline products, giving impetus to the development of the packaging film.

The development status quo of paper materials. Paper and cardboard consumption level is to measure the important symbol of national modernization level and civilization degree. With the rapid development of China's national economy, the paper products increased rapidly, for the development of Chinese papermaking industry has provided a broad market [2]. China papermaking industries grow by 17% in 2003, the growth rate of 20% in 2004. Since two accession, corrugated carton, cartons, paper bags, and the rapid development of printing industry, combined with foreign trade import trade expanded rapidly, directly stimulate the demand for paper products.

Glass packaging material. For glass packaging materials, food grade packaging is gradually promoting the use of borosilicate glass, the main component in addition to the silica, boron content 8%-13% [2]. The material is mainly characterized by good chemical stability, very few of dissolution, transparent, sweet sex too. For this type of product is from a security perspective, we should strengthen the dissolubility of arsenic, the control of heavy metal. For food packaging of rubber, the country has clear rubber health standard. Regular testing project mainly include heavy metal, potassium permanganate consumption, soluble organic matter, evaporation residue.

Plastic packaging toxicity of toxic substances in the analysis

Figure 1 is take 10 mu g/kg packaging simulation pollutant gas chromatographic analysis of ethanol solution, using the spectrum SCAN mode. Spectrum chart and clear packaging plastic main kinds of the organic matter.

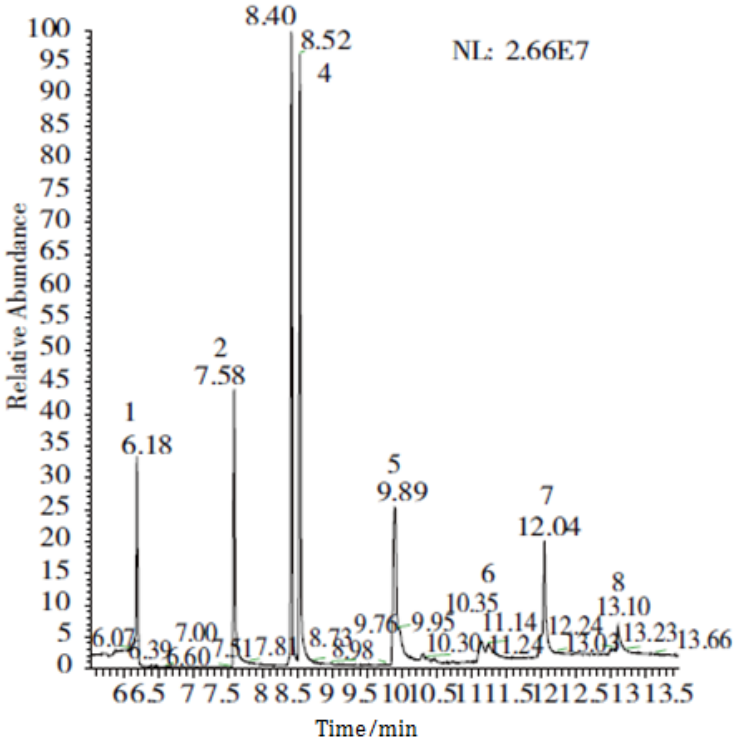

Fig. 1 Plastic packaging of organic components GC - MS

1. O-xylene, 2. Acetophenone, 3. Dodecanoic, 4. Naphthalene, 5. Diphenyl ether, 6. Diphenyl ketone, 7. Phthalate butyl acetate, 8. Methyl stearate

Toxic monomer vinyl chloride. Strong toxicity of vinyl chloride, vinyl chloride at room temperature for gas monomer vinyl chloride has the anesthetic effect can cause the human body four vasoconstriction and pain at the same time with carcinogenic and teratogenic effects [3]. The us food and drug administration points out that remaining in the PVC vinyl chloride after oral intake of the cancer, and thus prohibited PVC products for food packaging materials, China is now the use of polyvinyl chloride (PVC) as food packaging.

Toxic styrene monomer. Styrene is a colorless liquid, and the can generate polystyrene (PS) resin, can easily with other copolymer containing double bonds of unsaturated compounds. Styrene and butadiene and acrylonitrile copolymer, the copolymer can be used in the production of ABS engineering plastics, with butadiene copolymer latex can be generated (SBL) and synthetic rubber (SBR), and acrylonitrile copolymer AS resin. Have certain toxicity, styrene monomer can inhibit rat fertility, liver, kidney, such as weight, and styrene monomer is easy to be oxidized to an organism can be induced by mutation of compound phenyl epoxy ethane [3]. Many countries styrene monomer content of polystyrene packaging materials made limited regulation, such as provisions of food packaging in China polystyrene resin of styrene content must not exceed 0. 5%, American rules styrene content in polystyrene resin fat food contact below 5000 mg/kg, other food packaging polystyrene resin of styrene content below 10000 mg/kg.

Toxic monomer bisphenol A diglycidyl ether (BPA). Bisphenol A is a kind of widely used in food plastic packaging and tin cans, cans of inner wall coating of chemical substances [4]. Bisphenol A type of compound can lead to all sorts of biological reproductive functions decline in genital tumors, lowered immunity, and cause various reproductive abnormalities and disrupt the normal human body endocrine function.

Toxic monomer acrylonitrile. Colorless transparent liquid of volatile, taste sweet, slight odor rubber modification of acrylonitrile - butadiene - styrene (ABS) and styrene acrylonitrile (AS) is most commonly used. ABS, AS in the food industry is mainly used AS food packaging materials. AS there is used AS the heat resistance and transparency requirements of food packaging materials [4]. Acrylonitrile belongs to high toxic class, has the effect of met hemoglobin formation hematic disease, after entering the human body can cause acute poisoning and chronic poisoning.

Toxic isocyanate monomer. In the food packaging industry, isocyanine is used in the production of polyurethane packaging materials and adhesives, colorless and clear liquid, has strong excitant, it will encounter water hydrolysis to generate aromatic amine, which is a kind of carcinogen aromatic amine [4]. China GB 9683-2003 sanitary standards of the composite food packaging bags, after heating extraction treatment, packaging bags of aromatic amine (including free monomers and cracking of debris, in toluene diamine) content shall not be greater than 0. 04 mg/L, only lower than the set limit to is safe.

Toxic monomer polyester amide. On the solid material, polyester amide as the main chain of the molecule polymer is containing ester chain and amide linkage. A linear polyester amide and crosslinked polyester are amide. Crosslinked polyester amide is mainly used in plastics or as a plasticizer. Polyamide "nylon" in the field of food packaging often used as a food packaging film, also commonly used for holding of food cooking food packaging materials [5]. There is evidence to suggest that in the process of cooking, a lot of nylon 6 and residual oligomers - caprolactam, nylon monomer can infiltrate into boiling water.

Plastic food packaging materials in the migration of pollutants

Pollutants from plastic packaging into food migration process can be divided into three different stages: simple diffusion - dissolving - scattered.

The spread of migration. In food packaging, plastic polymer pollutant migration and mainly controlled by diffusion, diffusion is pollutants within the molecular structure of plastic macro performance of Brownian motion; the movement pattern is mainly follow the Fick diffusion law [5].

Pollutants dissolved. Pollutants dissolved in the plastic - food interface (interface adhesion to dissolve grease or solution provides a possible). If the contaminants in the food environment has good solubility, of varying concentrations of the pollutants on the interface is continuous; If solubility of

contaminants in the food is very poor, so its concentration in the interface change is discontinuous, so at this stage of pollutant migration mainly affected by the solubility property of pollutants [4].

Pollutant dispersion. Pollutants leave on dissolved in interface dispersed into the food. Dispersed phase is the main driver of office, which tend to be more disordered state.

The influence factors of contaminant migration

Main factors influencing on food migration of packaging materials are: packaging material of plasticizer concentration, storage time and storage temperature, food fat content and the contact area, etc. Including time and temperature is the main factor decided to migrate as shown in figure 2 and figure 3.

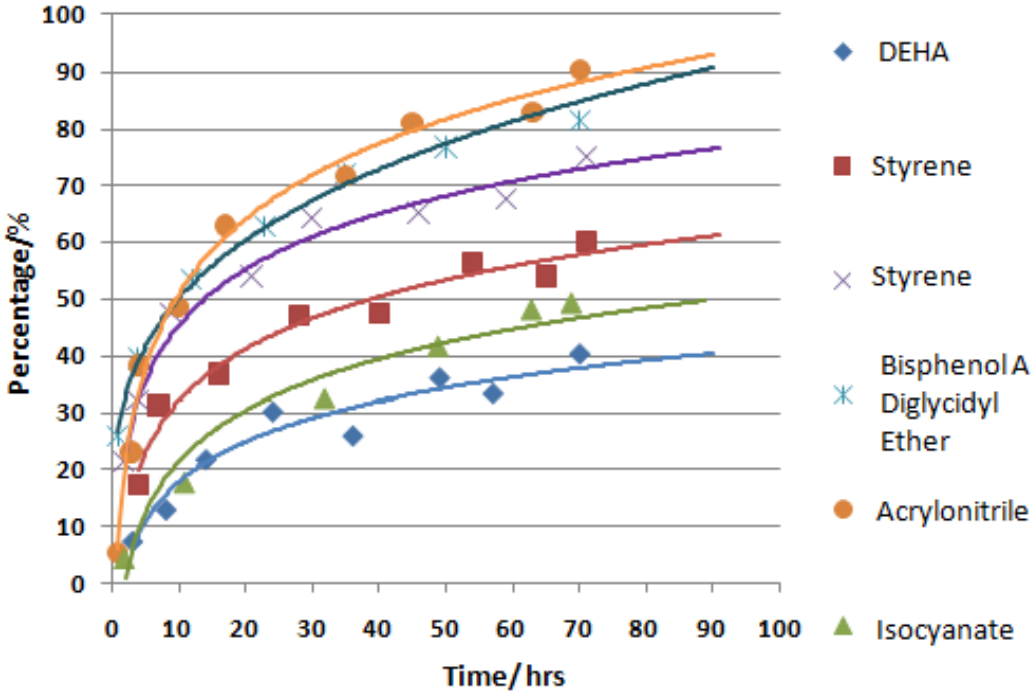

Fig. 2 Plastic chemicals in the migration characteristics over time

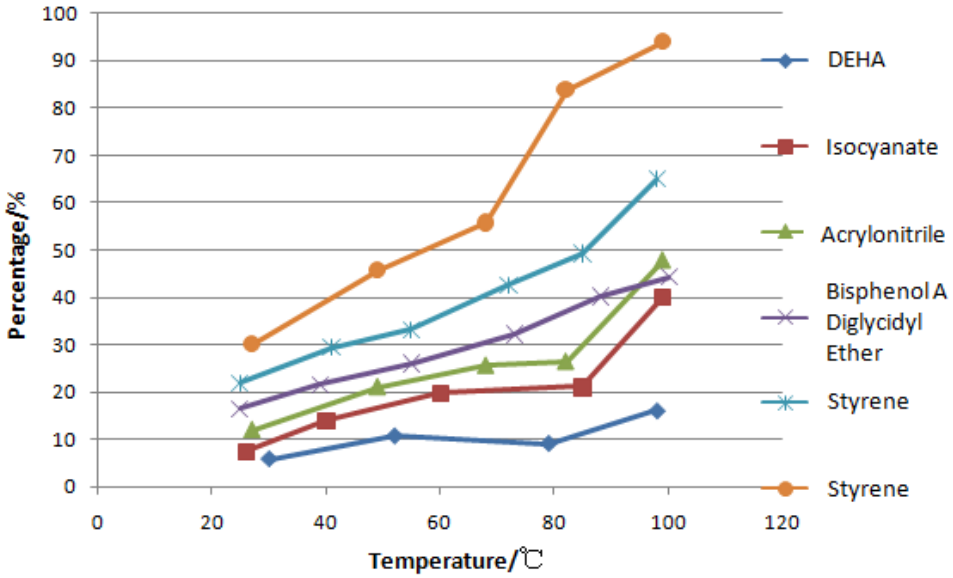

Fig. 3 Plastic chemicals with the temperature in the migration characteristics

In the food packaging plastic DEHA cheese food migration in the contact time, fat and moisture and the integrity of the cheese. Under the condition of 5 plus Or minus 0. 5 ℃ refrigerated, DEHA to Dutch cheese form the balance of the migration time of 100 h, and migrated Kefalotyri cheese balance time of 150 h, Roquefort migration time 240 h also does not have a balance, refrigerated after

240 h DEHA content in the above products are: 222.5 mg/kg (12.2 mg/dm^2), 345.4 mg/kg (18.9 mg/dm^2), and 133.9 mg/kg (7.3 mg/dm^2), in the packaging of these 3 kinds of cheese plastic DEHA content by 24.3, 37.8 and 14.6% respectively of the study was the migration amount has exceeded the EU regulations is the measure of the migration of the (10mg/dm^2 Or 60mg/kg). And DEHA distribution on the contact surface of the cheese, no more than 3.6 mm deep contact surface of the area [6].

May also affect migration and other means, for example, in drink water using gamma rays to replace conventional thermal sterilization, found that as the increase of the irradiation intensity DEHP migration to the water velocity increased obviously [6]; Shake the bottle will increase the migration amount of DEHP; If the freshly prepared croquette immediately strike with plastic film packaging, or prevent 5-30 min after packing, the migration of pollutants quantity 3. 5-14 times of the former is the latter; Bottled water in the bottle was almost undetectable DMP, DEP, BBP and DEHP, but stored in polyethylene bottle after 10 weeks, the total content of endocrine disruptors 0. 681 mu g/kg (but still will not cause health risks); Even under the condition of low temperature storage, there are still pollutants move into food, especially the low molecular weight components, such as BBP.

Summary

Food packaging material itself contains poisonous and harmful substances and their migration is one of the important factors that lead to food safety problem. At present, the world governments and consumers pay more and more attention to food contact materials, including food containers, utensils and health security problems of packaging materials, also made the more and stricter rules. China frequently in recent years received the European exports to China food contact materials of health security alert; Because of China's exports in some food packaging hygiene indexes do not conform to the requirements of the importing country and refused to import, caused huge economic losses to the enterprise. So on the one hand, requirements related to food enterprises in China should strengthen the health food packaging material quality control, familiar with the importer of packaging material itself health standards; On the other hand should strengthen the food packaging materials in the field of health security system of scientific research and the work, to cope with the developed countries in the field of China set up technical barriers to trade, safeguard the economic interests of the enterprise, more important is to ensure the safety of consumers eating.

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