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O 84. INDOOR FORMALDEHYDE EMISSION IN AIR AND HEALTH IMPACTS

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ABSTRACT: In this review, formaldehyde emission sources in indoor air and its effects on human health are examined. The most important sources of formaldehyde compound, which has several different varieties, have many different usage areas such as kitchen materials, binders in wooden materials and chemical materials. Nowadays, people spend most of their time in a closed environment. There are 3 kinds of formaldehyde according to usage area. Formaldehyde is polymerized to produce urea formaldehyde, melamine formaldehyde and phenol formaldehyde. These substances are volatile and have harmful effects on indoor air.

Keywords: Formaldehyde, indoor air quality, health, emissions

1. INTRODUCTION

The structure and characteristics of the urban climate affect the air pollution in the building. Before building the buildings, it is necessary to determine whether people will be affected in the future by looking at the city air pollution data. In the urban planning process, it is important to know, understand and interpret air quality data in planning. Knowing air pollution from transport and industry plays an important role in minimizing vulnerability. Modeling is used to make air pollution analyzes and prepare pollution maps. In addition to air pollution models, GIS is utilized. Models and methods developed to find intermediate values for pollutants in air pollution maps through GIS are applied on a large-regional scale. There are many types of models. The purpose of each is to reveal different data. In these maps, NO_2, acid rain, ozone concentration, PM ratio and so on. related data. At the same time, temperature differences, changes in wind speed, rain pattern, moisture content and so on. simulations of climatic conditions can also be obtained. Increased climatic and air emissions affect the topographic and meteorological conditions in the region and the air quality in the building. (Balık & Duman, 2014). Indoor air pollution is one of the areas where indoor air pollutants such as houses, schools, commercial and administrative office buildings and government buildings. People spend most of their time these places. The overall burden of disease is almost five times the burden of disease due to outdoor pollution. (Güllü, 2013).

In urbanization, measures should be taken to control indoor air pollution in areas with high levels of outdoor air pollution. In order to evaluate the areas allocated for urbanization and population growth, it is inevitable to construct buildings in areas where vehicle use is high. In this case, to ensure proper ventilation in the building; improvement of the materials used in the construction of buildings, ventilation entries of buildings must be made away from the source of pollution and ventilation system should be considered (Elbir et all, 2010).

The insulation materials used in the building, paint and plastic materials, wall paint, cleaning materials, furniture, coatings, adhesives affect the indoor quality. In confined spaces, harmful gases and particulate matter can accumulate. In this case, it affects the indoor air quality negatively. Chemical materials are used in the materials used to make them more durable and long lasting. The chemicals used are harmful to human health when evaporated. Particles and gases accumulated in a closed environment must be disposed of. To prevent accumulation, it is necessary to minimize the chemical used and to ventilate the indoor environment continuously. It is an important parameter affecting the temperature and humidity gases in the indoor air environment (Table 1). It affects the boiling point of gases with increasing temperature. According to the Gay –lussac law: As the temperature increases, the pressure increases,

and in this case the temperature and pressure are directly proportional. As the temperature increases, the kinetic energy of the gas increases.

Table 1. Boiling point temperature, density and dissolved substances of pollutant gases (URL 2)

Pollutant Gases	**Boiling Point Temperature (°C)**	**Density**	**Dissolved substances**
CO	-191,5 °C	1,14 kg/m³	Ethanol, water, benzene acetic acid, chloroform, ethyl acetate, ammonium hydroxide
CO_2	-57 °C	1.874 kg/m^3	Water
NO_2	21 °C	1,45 g/cm³	Water
SO_2	-10 °C	2,63 kg/m³	Water
Benzene	80,1 °C	876 kg/m³	Alcohol, acetic acid, acetone, chloroform, carbon tetrachloride, diethyl ether
Toluene	110,6 °C	867 kg/m³	Insoluble
Ozone	112 °C	2,14 kg/m³	-
Radon	-61,7 °C	9,73 g/cm^3	-
Formaldehyde	-19 °C	815 kg/m³	Water

Indoor pollutants are known to cause respiratory diseases. Among these, asthma, headache, allergies and respiratory system effects are prominent. Especially in excess of formaldehyde in human health, headache, nausea, cancer, respiratory system diseases, such as cause many health problems. Formaldehyde has many uses including laboratory, indoor, combustion, livestock and industrial areas.
Formaldehyde; is an organic, colorless, pungent and poisonous gas. Formaldehyde is used as a protective and sterilizing agent in the medical field, as well as in anatomy, histology and pathology laboratories. It is an inexpensive and simple method that protects the cell tissues and ensures that organic matter does not deteriorate in such methods as mummification. Detergents and cleaning materials, hand soaps, and formaldehyde are used in the cosmetics industry. It contains formaldehyde in preservatives used in adhesives, wall paints, insulation materials, stationary press fabrics, paints, coatings and paper products in indoor construction materials. At the same time, living things inside the building affect the environment. For example; Smoking inside the building increases formaldehyde emissions. Formaldehyde is used in many industrial areas because it extends the expiration date and protects the product.
There are 3 types of formaldehyde used in the industrial field. Formaldehyde polymerizes to form urea formaldehyde, melamine formaldehyde and phenol formaldehyde. Formaldehyde; urea formaldehyde, melamine formaldehyde and phenol formaldehyde resins are used as binders in kitchen utensils, electrical appliances, paper coating, insulation materials, cardboard, particle board, wood fiber board. Typical sources of formaldehyde in homes are wood products produced with urea formaldehyde glue. Of these, especially fiberboard products emit most formaldehyde. In the experiments, it was determined that it could be spread for months from office furniture made of formaldehyde fiber board. Formaldehyde emission from furniture to the environment increases with increasing ambient temperature and humidity. Resins used in the production of composite wood products are usually produced using urea formaldehyde glue. Emissions caused by urea formaldehyde-produced panels and furniture pose serious risks to human health, especially in confined environments. There is no limit value for formaldehyde in national legislation. Formaldehyde limit values in the internal environment are evaluated according to international legislation.

2. METHODS

In order to determine formaldehyde emissions, it is known that gaseous emissions are first determined by gas chromatographic studies. These Gas chromatography methods; thermal conductivity, flame ionization, nitrogen phosphorus, electron capture, atomic emission, photoionization, mass spectrometry.

Gaseous atoms, ions and molecules are stimulated by electrical discharge or heat to irradiate UV and visible areas.
Formaldehyde emission in indoor air is determined by technological devices. The gas chromatography used in the devices is the photoionization detector. Photoionized detector breaks molecules with high energy photons and converts them into positively charged ions. Because the ionization potential of formaldehyde molecule bombarded with UV light is lower than the energy of photon, positive ions are formed by breaking (URL1).

3. DISCUSSION AND CONCLUSION

People spend most of their time indoors. As the air flow is less in indoor environments than in outdoor environments, so pollution in the environment easily accumulates in indoor environments. If pollution is not controlled and reduced, it threatens human health. internal pollutants; CO, CO_2, SO_2, NO_2, benzene, toluene, ozone, radon, formaldehyde. To control indoor pollutants, pollution must be detected at the source. The air flow entering the building from the outside air environment affects the pollution. Exhaust gases, industrialization, heating and the types of fuels used affect the outdoor environment and accumulate in the indoor environment when we ventilate the building.
For this reason, knowing the plan during the urbanization process prevents the indoor air pollution caused by industry and transportation. In order to ensure proper ventilation in the building; The materials used in the construction of buildings should be improved, the ventilation entries of the buildings should be made away from the source of pollution and the ventilation system should be considered. Ventilation is important for removing harmful gases and particles in indoor air quality and cleaning the ambient air. Today, ventilation is possible with natural air flow or ventilation systems inside the building.
In order to reduce the amount of formaldehyde in the building, smoking should not be allowed indoors, cabinet, furniture and parquet should be used without wood glue. Air flow must be provided in the building so that formaldehyde accumulated in the building can be dispersed. Attention should be paid to the cleaning materials used in the buildings, cosmetics, soaps, shower gels should be checked by checking the content. Plastic materials should not be used in kitchen utensils and the materials used in the kitchen should be steel or glass products. Seasonal changes should be taken into account when ventilating the building. Pollutants from combustion and exhaust emissions may enter the building during ventilation.

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