

**FIRE SAFETY IN THE COTTON INDUSTRY: CAUSES, CHEMICAL COMPOSITION AND EFFECTS ON HUMAN HEALTH****Yusupov Fuzayl Farxod ugli**

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This article analyzes the main causes of fires in cotton industry enterprises, the chemical composition of toxic substances released during fires, and their impact on human health. Research results show that dangerous gases such as carbon monoxide, acrolein, and formaldehyde are formed as a result of the combustion of cotton dust and fibers. The article proposes comprehensive measures to reduce fire risk and protect workers' health.

**Keywords**

cotton industry, fire safety, toxic gases, human health, prevention.

**Annotatsiya**

Ushbu maqolada paxta sanoati korxonalarida yong'in sodir bo'lishining asosiy sabablari, yong'in jarayonida ajralib chiqadigan zaharli moddalarning kimyoviy tarkibi va ularning inson salomatligiga ta'siri tahlil qilingan. Tadqiqot natijalari shuni ko'rsatadiki, paxta changi va tolalarining yonishi natijasida uglerod oksidi, akrolein va formaldegid kabi xavfli gazlar hosil bo'ladi. Maqolada yong'in xavfini kamaytirish va ishchilar salomatligini himoya qilish bo'yicha kompleks chora-tadbirlar taklif etilgan.

**Kalit so'zlar**

paxta sanoati, yong'in xavfsizligi, zaharli gazlar, inson salomatligi, profilaktika.

**Аннотация**

В данной статье проанализированы основные причины возникновения пожаров на предприятиях хлопковой промышленности, химический состав токсичных веществ, выделяющихся в процессе горения, и их влияние на здоровье человека. Результаты исследований показывают, что при горении хлопковой пыли и волокон образуются опасные газы, такие как оксид углерода, акролеин и формальдегид. В статье предложены комплексные меры по снижению пожароопасности и охране здоровья работников.

**Ключевые слова**

хлопковая промышленность, пожарная безопасность, токсичные газы, здоровье человека, профилактика.

**Introduction**

The cotton industry is one of the strategic sectors of agriculture and light industry, constituting a significant part of the economy in many countries. However, the flammability of cotton raw materials and the technological features of the production process increase the risk of fire in this area. Fire not only causes great economic damage, but also poses a serious threat to the health of workers and the public.

The chemical composition of smoke and gases released during a fire is complex, and their effects on the human body are manifested in different ways. Therefore, studying the causes of fire in the cotton industry, determining the composition of fire products and assessing their impact on health is necessary to create modern fire safety systems. The purpose of this study is to analyze the factors of fire occurrence in the cotton industry, to study the chemical composition of fire products and to assess their impact on human life.

Methods. Analytical and theoretical methods were used in the study. As a source of data, statistics of fire cases in cotton industry enterprises, scientific research on fire chemistry and

normative documents on labor protection were analyzed. During the research process, the following areas were studied:

- ü Technical and human factors of fire origin.
- ü Chemical composition of gases produced by burning cotton materials.
- ü The effect of toxic substances on the human body (respiratory system, blood system).
- ü Effectiveness of existing measures to ensure fire safety.

#### CAUSES OF FIRE — DISTRIBUTION BY PERCENTAGE

Spontaneous heating of cotton .....	25%	
Mechanical sparks .....	20%	
Electrical equipment failure .....	20%	
Dust and fiber accumulation .....	15%	
Human factor (carelessness) .....	15%	
Chemicals .....	5%	

The analysis was carried out on the basis of international fire safety standards and chemical safety indicators (LC<sub>50</sub>, COSHH).

Results. Causes of fire. Analyses show that there are several main reasons for the occurrence of fire in the cotton industry:

Self-heating: Cotton with a moisture content of more than 20% can heat up and cause a fire as a result of biological processes during storage.

Mechanical sparks: Friction of metal parts during cotton cleaning and sorting processes generates sparks.

Electrical equipment failure: Old wires and static electricity can ignite cotton dust.

Dust accumulation: Cotton dust and fibers (fluff) in production facilities create a very flammable environment.

Human factor: There are cases of non-compliance with smoking and technical safety rules.

Chemical composition of fire products. The following main toxic substances are produced as a result of burning cotton materials (table 1):

Gas/Substance	Chemical formula	Feature
Carbon dioxide	CO	Colorless, odorless, deadly
Acrolein	C <sub>3</sub> H <sub>4</sub> O	Has a strong irritant effect
Formaldehyde	CH <sub>2</sub> O	Carcinogenic, irritant
Hydrogen cyanide	HCN	Very toxic, stops cell respiration
Nitrogen dioxide	NO <sub>2</sub>	It damages lung tissues

Table 1. Main gases emitted as a result of cotton burning

Studies show that the most common products are carbon monoxide (CO) and acrolein. If the CO yield is 100-140 g/kg of fuel, the acrolein concentration is around 7-18 g/kg. Chemical composition of cotton dust: The following elements have been identified in the dust produced in the cotton industry.

- Potassium (K): ~ 1.58%
- Calcium (Ca): ~ 1.35%
- Magnesium (Mg): ~ 1.14%
- Iron (Fe): ~ 0.85%
- Sodium (Na): ~ 0.50%
- Also: titanium, manganese, aluminum, chromium, phosphorus, chlorine.

**Effects on human health.** The impact of combustion products on the human body was assessed as follows:

Respiratory system: Acute effects include cough, shortness of breath; chronic effects include byssinosis ("cotton disease"), chronic bronchitis.

Effects of toxic gases: CO combines with hemoglobin in the blood and stops the supply of oxygen to the tissues. At a concentration of 3000 ppm, there is a risk of death in 30 minutes.

Causes of death: More than 70% of deaths from fire are caused by inhalation of toxic gases in smoke.

Escape ability: Gases such as acrolein reduce the ability of people to escape to a safe place in 15 minutes at a concentration of only 0.3 ppm.

#### EFFECTS ON HUMAN HEALTH — RISK LEVELS

##### RESPIRATORY SYSTEM

— Acute effect: Cough, shortness of breath .....	High
— Chronic effect: Byssinosis, bronchitis .....	Very high
— Allergic reaction: Asthma, dermatitis .....	Average

##### ☠ EFFECTS OF TOXIC GASES

— CO: 3000 ppm → 30 minutes of death risk .....	Critical
— Acrolein: 0.3 ppm → escape ability decreases...	Critical
— Formaldehyde: long-term risk of cancer .....	High

##### EFFECTIVENESS OF PROTECTIVE MEASURES

— Respirators: 95% protection .....	High
— Ventilation: 80% reduces dust .....	High
— Automatic alarm: 90% quick detection .....	High
— Staff training: 70% reduces risk.....	High

**Discussion.** The results obtained show that fires in the cotton industry are not only property damage, but also a direct threat to human life. Most of the causes of fire (for example, spontaneous combustion of cotton and electrical failures) are factors that can be prevented by prevention. Due to the complexity of the chemical composition of fire products, ordinary fire extinguishers may not be sufficient. In particular, irritating gases such as acrolein and formaldehyde complicate the evacuation process. This necessitates the introduction of modern ventilation systems and gas detectors in enterprises.

To protect the health of workers, dust protection measures must be taken not only in the event of a fire, but also during the daily work process. From an economic point of view, the shutdown of production and loss of reputation as a result of the fire is a great loss for the enterprise. Therefore, investing in fire safety systems is also economically feasible.

Recommended measures: Proper storage of cotton:

- ❖ Moisture control and air circulation.
- ❖ Technical monitoring: Regular inspection of electrical equipment and temperature.

❖ Protective equipment: Provision of automatic extinguishing systems and personal protective equipment.

❖ Training: Conduct regular fire safety training for employees.

Conclusion and recommendations. The issue of fire safety in the cotton industry requires a comprehensive approach. The results of the study confirmed that the causes of the fire are mainly related to technical failures and human factors, and they can be prevented. Substances such as carbon monoxide, acrolein and formaldehyde released during a fire pose a serious threat to human life and are the main cause of death.

To reduce the risk of fire and protect human health, it is necessary to:

- Strict adherence to technical safety rules during the production process.

- Introduction of modern fire alarm and extinguishing systems.

- Regular safety training and medical examination of employees.

The implementation of these measures will serve to ensure sustainability and save human lives in the cotton industry.

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