

Comprehensive Protection of Wood with Compositions Based on Nitrogen and Sulfur-Containing Oligomeric Compounds

Aziza Xolboyeva¹, Xayit Turayev², Fayzulla Nurkulov³

¹Doctoral Student, Termez State University, Termez, Uzbekistan

²Doctor of Chemical Sciences, Professor, Termez State University, Termez, Uzbekistan

³Doctor of Technical Sciences, Head of Technology, Tashkent Scientific Research Institute of Chemical Technology, Tashkent, Uzbekistan

Abstract The article shows the possibility of obtaining a new polyfunctional oligomer based on sulfur and nitrogen-containing compounds for the fight against termites, synthesized on the basis of local raw materials, which increases the amount of antiseptic efficiency and provides bioprotective properties. In addition to studying the physicochemical properties of the oligomers obtained, the use of aqueous solutions of organic nitrogen and sulfur oligomers prepared from local raw materials in order to increase the resistance of wood materials to termites led to positive results by 87%.

Keywords Wooden building material, Nitrogen and sulfur-containing oligomer, Termites, Biosecurity, Synergistic effect

1. Introduction

Sulfur composite materials are special types of building materials, in the manufacture of which technical sulfur in any commercial form (powdered, liquid, lump, polymer, and other types) and or sulfur-containing waste are used as a binder (the sulfur content is not less than 30 %; with a lower sulfur content, the waste is enriched with technical sulfur) [1-3].

One of the problems that wooden construction materials cause great damage to agriculture, as well as historical buildings and structures, is termites, which are being fought all over the world.

Today, the damage caused by termites around the world is increasing year by year. In West Africa, termite damage to buildings accounts for 10 percent of current repair costs, while in the United States, termite damage is estimated at \$ 1.5 billion a year and \$ 20 billion worldwide. One family of 25,000 termites per 100 cm³ consumes an average of 50,000 cm³ of cellulose per year [2-4].

Two species of termites (*A. turkestanicus* Jacobs, *A. ahngerianus* Jacobs.) belonging to the genus *Anacanthotermes* are widely distributed in Uzbekistan, especially in the last 20-30 years in almost all regions of the country and in the Republic of Karakalpakstan, which caused great damage to homes, agricultural buildings, and even historical monuments [2-5].

Chemicals play an important role in termite control. High results can be achieved with organic substances containing sulfur and nitrogen.

2. Materials and Methods

Sulfides of elements with valence s-electrons have a mixed ion-covalent chemical bond: covalent between sulfur atoms and ionic between metal and sulfur atoms. With a decrease in the ionization potential of these metals, the ability of sulfur atoms to form covalently bound groups with each other increases and, accordingly, the ability of metals to form a large number of polysulfide phases. Especially prone to the formation of polysulphides of metals with low first ionization potentials. Thus, sodium (ionization potential $I_1 = 5,14$ eV) forms the following sulfides: Na₂S, Na₄S₂, Na₂S₂, Na₄S₅, Na₂S₃, Na₄S₇, Na₂S₄, Na₄S₉, Na₂S₅; as numerous sulfides formed by potassium ($I_1 = 4,34$ eV), a smaller number of sulfides form beryllium ($I_1 = 9,32$ eV; $I_2 = 18,21$ eV), calcium ($I_1 = 6,11$ eV; $I_2 = 11,87$ eV) and barium ($I_1 = 5,21$ eV; $I_2 = 10,00$ eV), which Have relatively higher Ionization potentials.

Experimental part. New polyfunctional oligomers based on sulfur and nitrogen-containing compounds have been synthesized, with the combined introduction of which into oligomeric binders, a synergistic effect is observed.

Obtaining new synthesized compositions of bioprotective additives for wood construction materials that have high antiseptic efficiency, are environmentally safe and economical is an urgent task today.

Physical and chemical properties were studied: density, and the main operational and technical characteristics in bioprotective wood construction materials.

Data on the physical and chemical characteristics of nitrogen-and sulfur-containing oligomeric flame retardants are presented in table.1.

Table 1. Physical and chemical indicators of sulfur-containing oligomers

Indicators	Sulfur and nitrogen-containing oligomers
Density, ρ/cm^3 ГОСТ 15139-69	1,03
Acidity of solution pH	7,0-7,5
η_{sp}	0,064
Solubility	Water
Appearance and color	Oligomeric substance honey

Application of defenseless antiseptic materials is possible only on wooden elements that will not be subjected to further mechanical influences [3]. Before processing, the wood must be completely cleared of bark, resin, dirt, dust, and colorants.

3. Result and discussion

As a result, an antiseptic agent was obtained, in which it was possible to improve not only the bioprotective properties, but also the most important performance indicators (table 2.). In addition, aesthetic indicators were improved: the natural color of wood as a result of processing acquired a deeper yellowish hue.

Table 2. Main operational and technical characteristics for bioprotective wood construction materials

Biological resistance, according to GOST 9.048-89	Балл 1
Chemical and corrosion resistance	High Performance
Consumption for efficiency	100-200 г/кв.м.
Ambient temperature during processing	+40°C - 0°C

Processed wood construction materials and structures are not only capable of biological destruction, but also do not emit toxic chemicals into the environment that are dangerous to human life and ecology and create unpleasant odors. As one of the safest for human life and nature, nitrogen - and sulfur-containing oligomers can be recommended for biosecurity and prevention of premature rotting of wood parts and structures used in buildings and structures for various purposes, including residential and public buildings with mass and long-term stay of people.

In order to increase the resistance of wood materials to termites, 87% of positive results were achieved using aqueous solutions of organic oligomers containing nitrogen and sulfur, made from local raw materials.

In addition, experimental tests were conducted to study the effects of termites on wooden building materials. One part of the wood material was treated with water-soluble chemicals, and the other part was used as raw, dried termites as raw materials. In the experimental process, 40 working termites were used, a total of 100 g of termites were fed. Experimental observations revealed complete destruction of termites in 25-27 days.

Table 3. Biological efficiency of water solutions nitrogen and sulfur containing oligomers in relation to termites in the laboratory

chemical samples	number of dead termites per month (%)						Number of termites термитов	number of termites Biological Биологическая эффективность (%)
	5	10	15	20	25	27		
Nitrogen and sulfur-containing oligomer	48,2±2,9	62,7±2,4	69,8±2,0	80,5±1,7	85,1±4,0	87,2±2,0	40±1,0	87,2±2,0
Control	-	-	-	-	-	-	-	-

When wood treated with an aqueous solution of nitrogen-and sulfur-containing oligomers was used as raw material for termites, the average number of termites decreased from 48.2% to 69.8% after 5-15 days, and then from 15.27 days to 87.2%.

4. Conclusions

The analysis of the work shows the prospects for the development and effectiveness of the use of composite materials nitrogen and sulfur-containing oligomers as bioprotective agents for trees of construction materials.

In Uzbekistan, termite control has been highly effective in the widespread use of termites in strategic settlements.

According to the results of this experiment, preventive measures against termites can lead to high economic efficiency in the future by building strong building materials.

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- mahsus son, - В. 83-87. Когда дерево, обработанную водным раствором азотсодержащих и серосодержащих олигомеров, использовалось в качестве сырья для

термитов, среднее количество термитов уменьшилось с 48,2% до 69,8% через 5-15 дней, а затем с 15,27 дня до 87,2%.

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