

2. Меньишутина, Н.В. Получение аэрогелей на основе диоксида кремния методом сверхкритической сушки / Н.В. Меньишутина, А.М. Каталевич, И. Смирнова // *Сверхкритические флюиды: теория и практика*. – 2013. – Т. 8, № 3. – С. 49-55.

3. Васильева, И.Л. Перспективы применения аэрогелей в строительстве / И.Л. Васильева, Д.В. Немова // *Alfabuild*. – 2018. Т. 4, № 6. – С. 135-142.

4. Rosizol.com: поставщик теплоизоляционных материалов [Электронный ресурс]. – СПб.: Корда, 2019. – Режим доступа: <https://www.rosizol.com>, свободный. – Загл. с экрана.

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## **EMISSION OF FORMALDEHYDE INTO ATMOSPHERIC AIR IN THE PROCESS OF WOODWORKING**

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*It was established that the main air pollutants in the woodworking process are formaldehyde and phenol. Using the example of Rechitsadrev OJSC, it is shown that 40% of the gross amount of formaldehyde contained in resins enters the atmosphere. The greatest emission occurs when applying resin and pressing chipboards.*

Woodworking is one of the fast-growing and promising industries. Woodworking products are the most popular and cover virtually all branches of the national economy, as more than twenty thousand different products and products are currently produced from wood raw materials [1].

The woodworking industry is engaged in processing and processing of wood, mainly specializes in the production of sawmill materials, furniture, fiberboard and chipboard, matches, door and window blocks, parquet, plywood, sports equipment, etc. To a simple tree turned into a high-quality material, it is necessary to process it correctly. For this purpose, enterprises use special equipment and raw materials. In addition, thanks to advances in wood processing, it is possible to start up the whole tree, down to its last knot [2].

It is possible to increase profit, diversify the list of products and make the enterprise more waste-free and environmentally friendly – for this purpose there is a deep processing of wood.

The sources of release of pollutants into the atmosphere at the enterprises include technological equipment involved in the production of works [3].

In the process of shaving and veneering of panels with natural and synthetic veneers, adhesive resins containing free phenol and formaldehyde are used. The main sources of pollution of the working area and ventilation emissions at enterprises for the production of chipboard and plywood (composite materials made of wood) are the following processes and premises [4]:

- site of the main conveyor and press;
- site preparation of binders;
- finished goods warehouse;
- site placement of adhesive rollers;
- site of placement of driers of the smeared interline interval and hot presses;
- site of placement of cooling chambers;
- site of the adhesive rollers and hot presses;
- site of exposure of veneered products;
- site of priming and painting of finished products.

Let's consider the modern enterprise of JSC Rechitsadrev specializing in production of office and household furniture, chipboard and laminated plates, plywood glued, latoflex, briquettes fuel.

The allocation of pollutants by stages of the technological process of plywood production is presented in table 1.

In the finished product remains 70 % of free phenol and formaldehyde (5 % of them go to waste water). Consequently, only 30 % of the gross amount of free phenol and formaldehyde, which are distributed to the sites, enters the atmosphere. Possible distribution of the gross amount of formaldehyde and phenol by sources and sites.

By source: – point sources-90 %;  
– linear sources-10 %.

By sites: – on glue rollers-10 %;  
– on driers of the smeared veneer and hot presses-75 %;  
– from cooling chambers-15 %.

The content of free phenol and formaldehyde in adhesive materials is presented in table 2 [6].

Removal of harmful substances is carried out by local suction exhaust and General ventilation.

Table 1 – Release of pollutants in plywood production

Site of production of plywood	Pollutants			
	Dust	Phenol	Formaldehyde	Ammonia
Plywood raw material cutting section	+	-	-	-
Site of hulling of churak	+	-	-	-
Site of sorting of an veneer	+	-	-	-
Site of repair of an veneer	+	-	-	-
Site of cutting of puff plywood	+	-	-	-
Site of sorting of plywood	+	-	-	-
Site of packing of plywood	+	-	-	-
Wood laminated plastics production site	+	+	+	-
Site of pasting of an veneer	-	+	+	+
Site of preparation of resins	-	+	+	+

The technology of gluing and facing of wood and wood materials based on urea and phenol-formaldehyde resins is associated with the release of free formaldehyde and phenol vapors when performing technological operations on applying glue to the workpieces, their exposure to the applied glue, gluing in presses and exposure after gluing (facing) [4].

Urea-formaldehyde and phenol-formaldehyde adhesives, resins are made on the basis of phenol and formaldehyde. They are much cheaper than alternative resins (PVA emulsion, epoxy) and at the same time provide acceptable strength, but phenol and formaldehyde belong to the 2nd class of danger and affect humans at very low concentrations on the respiratory system, skin and eyes.

In the process of chipboard production, the main technological operations, during which the release of free formaldehyde, phenol and ammonia, depending on the brand of resin used, are chip tarring, hot pressing and aging of finished products.

Table 2 – Content of free phenol and formaldehyde in adhesive materials

Name of resins, brand	Mass fraction, %		Relative amount of formalde- hyde,%
	free formaldehyde	free phenol	
carbamide-formaldehyde			
CF- low-toxic	0,30		0,3
CF - liquid fast-solidifying	0,90		0,3
CF fast- solidifying	0,80		0,3
CF - liquid	1,00		0,3
urea-formaldehyde			
UCR-A	1,20		0,4
U-19-62-A	1,00		0,4
CF-68A	1,00		0,4
UF	3,0-4,0		-
U-60	1,0-1,5		-
U-70	1,5-3,0		-
phenol-formaldehyde liquid			
RPL -3011	1,00	2,50	0,5
RPL -3013	0,18	0,18	0,5
RPL -3014	0,15	0,10	0,5
RPL -3015	1,50	1,00	0,4
RPL -3016	4,00	5,00	0,4
RPL -3024	0,08	0,08	0,4
impregnation resins			
MFPC-1	no more than 0,20		0,4
MFPC -2	no more than 1,00		0,5
PMF-1	no more than 1,00		0,5
PNF-2	no more than 1,00		0,5
MMPK-25	1,40		0,5
MMPK-50	1,10		0,5
MFP	0,75		0,5

The atmosphere receives 40 % of the gross amount of free formaldehyde or phenol contained in the resin of this brand, which is distributed in the following way:

1. The site of the main conveyor and press – 36 %.
2. The site of preparation of binders – 3.7 %.
3. Finished products warehouse (exposure) – 0.3 %.

Of this amount, the atmosphere is emitted:

1. Ventilation systems of local suction from technological equipment – 90 %.
2. General exchange exhaust ventilation from the upper zone of the premises – 10 %.

In the manufacture of synthetic veneer, the release of free formaldehyde occurs during the impregnation of the tecopaper and subsequent drying.

Phenol, formaldehyde and other chemicals can simply be removed from the work area and industrial premises by means of exhaust ventilation and released into the atmosphere. But there are two main difficulties:

- the need to supply and, accordingly, to heat the supply air to the premises;
- restrictions of state bodies on emission of harmful substances into the atmosphere [7].

As a result, many manufacturers of plywood and chipboard are faced with the task of cleaning the ventilation emissions and the air of the working area from formaldehyde and phenol. At the moment, there are several technologies for air purification: absorption (activated carbon), scrubbers (absorption into liquid), bio-cleaning, after-burning, catalytic, photocatalytic and gas-discharge-catalytic. All these technologies have both positive and negative sides.

### References

1. Volynsky, V.N. *Technology of wood boards and composite materials: educational manual / SPb.: Publishing house "Lan," 2010. – 336 PP.*
2. Boldyrev, V.S. *Technology of sawmilling and woodworking, M., 2011. 99 PP.*
3. Kakareka S.V., Ashurko Yu. G. *Analysis and assessment of sources of formaldehyde emissions into the atmospheric air in Belarus. Environmental management. Issue. 21. 2012. – P. 75 – 81.*

4. *Temporary methodological guidelines for calculating emissions of pollutants into the atmospheric air from the woodworking industry. Petrozavodsk, 1992.*

5. *Technological regulations of production of particle boards at JSC "Rechitsadrev" – Rechitsa, 2007.*

6. *Inventory of sources of emissions of pollutants into the atmosphere for JSC "Rechitsadrev". Gomel. 2018.*

7. *Anokhin, A.E. Reducing the toxicity of furniture / A.E. Anokhin. Moscow, 2002. – 128 PP.*

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**АНАЛИЗ И МЕТОДИЧЕСКИЕ РЕКОМЕНДАЦИИ  
ПО СНИЖЕНИЮ ВОЗДЕЙСТВИЯ ВРЕДНЫХ  
ПРОИЗВОДСТВЕННЫХ ФАКТОРОВ  
НА РАБОЧИХ МЕСТАХ МАШИНИСТА  
АВТОМОБИЛЬНОГО КРАНА И ВОДИТЕЛЯ  
ПОГРУЗЧИКА**

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*Выполнен анализ условий труда на рабочих местах машиниста автомобильного крана и водителя погрузчика, рассмотрены действия вредных производственных факторов на организм человека, предложены методы снижения воздействия вредных производственных факторов на рабочих местах*

В настоящее время среди вопросов санитарии и гигиены труда актуальным продолжают оставаться проблемы воздействия вредных факторов производственной среды. Правильно организованная работа по оптимизации условий труда повышает дисциплинированность работников, что, в свою очередь, ведет к повышению производительности.

Профилактика профессиональных заболеваний, организация полноценного отдыха и питания работников, обеспечение их спецодеждой, выполнение социальных льгот и гарантий, приводит к снижению воздействия вредных производственных факторов [1].

Так, согласно ст. 209 Трудового кодекса РФ, вредный производственный фактор – это производственный фактор, воздействие которого на работника может привести его к заболеванию.