ISNN 3030-3907

2026
MAY
ISSUE - 5
VOLUME - 3

DEVELOPMENT OF SCIENCE

scientific journal



Development of science

Ilmiy jurnal

MAY 2026
Issue - 5, VOLUME - 3

ISSN 3030 -3907

Ilmiy jurnal OAK rayosatining 2024 yil 27 sentabrdagi 361-son qaroriga asosan 02.00.00 kimyo fanlari hamda 2025 yil 12 fevral 367- son qaroriga asosan 05.00.00 texnika fanlari bo‘yicha falsafa doktori (PhD) va fan doktori (DSc) ilmiy darajasiga talabgorlarning dissertatsiya ishlari yuzasidan dissertatsiyalari asosiy ilmiy natijalarini chop etish tavsiya etilgan milliy ilmiy nashrlar ro‘yxatiga kiritilgan.

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ISSN 3030-3907

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EFFECT OF URETHANE MODIFIER CONTENT ON THE ADHESION EFFICIENCY OF EPOXY COATINGS TO STEEL SURFACE.

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Abstract Existing protective polymer coatings were analyzed, and the effect of urethane and silicon-diurethane modifiers on the adhesion strength of epoxy resins was investigated. The results showed that increasing the ratio of hydroxyurethane to epoxy resin up to 15:85 improves adhesion strength by 20% compared to the initial sample. This improvement is attributed to the increased proportion of urethane bonds in the system. However, increasing the modifier content to 30% leads to a pronounced reduction in strength, which can be attributed to the insufficient availability of epoxy groups necessary for the formation of a cross-linked network during the curing process. The resulting hybrid oligomer is characterized by an epoxy value of 6.84% and an epoxy equivalent weight of 617.3 g/mol. It was also established that increasing the curing temperature from 120 °C to 150 °C reduces the curing time from 90 minutes to 30 minutes. Samples based on silicon-diurethane demonstrated adhesion strength values nearly identical to those of the initial samples across all temperature ranges and curing durations.

Keywords: polymer coating, epoxy resin, hydroxylurethane, silicon diurethane, adhesive strength, epoxy number, epoxy equivalent.

Annotatsiya. Mavjud himoya polimer qoplamalari tahlil qilindi va epoksid smolalarning adgezion mustahkamligiga uretan hamda kremniydiuretan modifikatorlari miqdorining ta’siri o‘rganildi. Tadqiqot natijalari shuni ko‘rsatdiki, gidroksiuretan va epoksid smolasi nisbatining 15:85 gacha oshirilishi dastlabki namunaga nisbatan adgezion mustahkamlikni 20% ga yaxshilaydi. Bu holat tizimda uretan bog‘larining ulushi ortishi bilan izohlanadi. Biroq, modifikator miqdorining 30% gacha oshirilishi natijasida mustahkamlik keskin kamayadi, bu esa qotirish jarayonida to‘rsimon struktura hosil bo‘lishi uchun epoksid guruhlarining yetishmasligi bilan bog‘liq. Olingan gibrid oligomer uchun epoksid soni 6,84% ni, epoksid ekvivalenti esa 617,3 g/mol ni tashkil etdi. Shuningdek, qotirish haroratining 120 °C dan 150 °C gacha oshirilishi jarayon davomiyligini 90 daqiqadan 30 daqiqagacha qisqartirishi aniqlandi. Kremniydiuretan asosidagi namunalar esa barcha sinov haroratlari va qotirish vaqtlarida dastlabki namunalar bilan deyarli bir xil mustahkamlik ko‘rsatkichlarini namoyon etdi.

Kalit so‘zlar: polimer qoplama, epoksi qatroni, gidroksiuretan, kremniy diuretan, yopishqoqlik kuchi, epoksi soni, epoksi ekvivalenti.

Аннотация. Проведен анализ существующих защитных полимерных покрытий, а также исследовано влияние уретановых и кремнийдиуретановых модификаторов на адгезионную прочность эпоксидных смол. Результаты показали, что увеличение соотношения гидроксиуретана к эпоксидной смоле до 15:85 приводит к повышению адгезионной прочности на 20% по сравнению с исходным образцом. Данный эффект объясняется увеличением доли уретановых связей в системе. Однако дальнейшее увеличение содержания модификатора до 30% вызывает значительное снижение прочности, что связано с недостаточным количеством эпоксидных групп, необходимых для формирования пространственно-сшитой структуры в процессе отверждения. Полученный гибридный олигомер характеризуется эпоксидным числом 6,84% и эпоксидным эквивалентом 617,3 г/моль. Также установлено, что повышение температуры отверждения с 120 °C до 150 °C сокращает продолжительность процесса с 90 до 30 минут. Образцы на основе кремнийдиуретана продемонстрировали значения адгезионной прочности, практически идентичные исходным образцам во всем диапазоне температур и времени отверждения.

Ключевые слова: полимерное покрытие, эпоксидная смола, гидроксилуретан, кремнийдиуретан, адгезион- ная прочность, эпоксидное число, эпоксидный эквивалент.

INTRODUCTION.

The destruction of metal and other structures as a result of interaction with the surroundingaggressive environment leads to significant economic costs. In recent years, numerous scientific and practical studies have been conducted aimed at creating protective coatings based on inorganic and organic substances and their compositions. [11; 8; 10; 1].

In construction practice, materials based on alkyd, perchlorovinyl resins, vinyl chloride copolymers, polyvinyl acetals, fluorinated polymers, epoxy resins, polyurethanes, furyl resins, petroleum polymer resins, chlorosulfonated polyethylene, chloroprene compounds, thiokols, etc. have found application [2]. The share of epoxy coatings is about 50% of the total world production of all types of resins [4]. Composites based on epoxy resins are widely used in the manufacture of protective, structural, waterproofing and decorative coatings, laying floors, and installing plaster coatings [5]. Coatings based on epoxy resin have proven themselves well for protecting surfaces from the effects of alcohol, wine, and fruit juices.

Modification of epoxy polymer is the only program for improving the adhesion, structure-forming and other characteristics of the protective coating. A

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widely used modifier is a polyurethane oligomer. In some cases, this oligomer is used to increase the impact strength of the resin [3]. As noted by the authors of [9], polyurethane macromolecules are mainly bound to the epoxy oligomer due to the interaction of a physical nature. At the same time, they do not exclude the presence of chemical bonds between these macromolecules, and it is these bonds that play a decisive role in improving the tensile strength, which is associated with the formation of a grafted network structure. A chemical bond is formed between the terminal isocyanate groups with the epoxy group. The formation of this chemical bond is also proven in [13], and an increase in the impact strength of the epoxy resin is explained.

Most of the works are aimed at improving the characteristics of polymer composite coatings, namely the glass transition temperature and other physical and mechanical properties. The improvement is due to the ratio of the initial oligomers, and at epoxy/polyurethane values of 1.5, the maximum increase in impact strength is observed [12]. In this work, the change in strength characteristics is explained by the formation of hydrogen bonds between the hydroxyl and isocyanate groups of the epoxy and polyurethane polymers, respectively.

Epoxy-siloxane polymers are classified as a supermodification of epoxy resins and are characterized by the properties of silicones and epoxides [7]. The epoxy component is primarily responsible for curing, while the siloxane groups impart high thermal stability and anti-corrosion properties The resins are characterized by increased resistance to atmospheric and temperature influences. Some varieties of such resins maintain their original technological characteristics after heat treatment in the temperature range of 200–300 °C. Such coatings are resistant to sunlight and retain their gloss and adhesive strength for several months.

The authors are conducting research on the creation of modified epoxy oligomers characterized by increased adhesive properties and anti-corrosion properties. Early studies covered data on the processes of synthesis of hydroxylurethane (HUR) and silicon diurethane (SDI) based on non-toxic 1,2-propylene carbonate and 1,3-propylenediamine, which were successfully used to modify the commercial epoxy resin ED-20 [6].

EXPERIMENTAL PART.

Epoxy resin (ED-20) and its modified forms were selected as anti-corrosion coatings for the study [6]. Epoxy-urethane and silicon-epoxy-urethane compounds were obtained on the basis of hydroxylurethane (ГУС) and silicon-diurethane (КУС), which were conventionally designated as EUS and SiEUS.

Steel C35E was chosen as the metal substrate, onto which a mixture of

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modified ED-20 and hardener was applied.

The hardener isophorone diamine is a mixed amine with a faint odor. This compound is characterized by low viscosity values (dynamic viscosity is approximately 18±0.5 mPa*s at 20 °C). The coating was obtained by applying a layer of material to the surface of the plate with a brush. Application was performed at least twice, and the coating thickness was approximately 20 μm. The working surface of the steel was 10 cm^2. For this, the steel surface first underwent a preparatory stage in the form of surface degreasing, drying the steel material, polishing with sandpaper and treating with acetone. Then the coating was cured at 150 °C for 15-30 min.

The determination of the adhesive strength of coatings under shear was carried out in accordance with GOST 14759-69 using an OR type adhesion meter.

The content (%) of the epoxy group was determined according to GOST 12497-78. The epoxy equivalent values were calculated based on the epoxy number.

RESULTS AND DISCUSSION.

The main task in creating composite anti-corrosion coatings is to optimize their composition by varying the amount of additives introduced, thereby stabilizing the required performance characteristics of the coatings. Anti-corrosion coatings, being composite materials containing oligomers, fillers, pigments, hardeners, and others, exhibit a variety of technological characteristics. The amounts of additives introduced vary widely, as does their nature. To date, numerous additives are known, and their effect on the characteristics of finished materials has been studied. However, the results of numerous studies have also shown the impossibility of predicting their characteristics, which depends not only on the amount of components introduced, but also on the method of their introduction, their dispersion, and the surface characteristics of the additives introduced.

Studies were conducted to establish the optimal ratios of ED-20/ГУС; ЭД-20/КУС, as well as the composition of hardeners for the adhesive strength of coating films. Data on the composition of the modified epoxy resin are given in Table. 1.

Table 1.

Composition of modified epoxy resin, % (mass)

Name of the verified EC	ЭД-20	ГУС	КУС
ЭУС1	95	5	
ЭУС2	90	10	
ЭУС3	85	15	

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SiЭУС1	95		5
SiЭУС2	90		10
SiЭУС3	85		15

To establish the amounts of hardener, the amounts of epoxy groups in the modified ED-20 (epoxy number/42) were determined and are given in Table. 2.

Table 2.

Main characteristics of hybrid resins

Sample	Epoxy number, %	Epoxy equivalent, g/mol	Amount of hardener*, g/100 g of resin
ЭУС1	17,80	235,9	36,0
ЭУС2	15,61	269,0	31,6
ЭУС3	13,42	313,0	26,5
SiЭУС1	18,97	221,4	38,4
SiЭУС2	17,89	234,7	36,2
SiЭУС3	16,77	250,5	33,9

* *Изофорондиамин.*

According to the methodology, the values of the epoxy number and epoxy equivalent were determined. As shown in Table 2, with an increase in the modifiers of the epoxy oligomer, the epoxy number (e.n.) of the hybrid material decreases. The decrease in epoxide number occurs due to the opening of the oxirane ring by the amino groups of the modifier, leading to the formation of hydroxyl groups Based on the data obtained, the required amounts of hardener were calculated. However, in practice, the required amounts of hardener are always greater compared to the calculated values.

Adhesion strength was studied using daily aged coatings. For this, the samples were applied to the surface of a steel sample, cured at a temperature of 110–150 °C for 30–120 minutes, then at room temperature for 24 hours. The effect of temperature and curing duration on the adhesion strength of hybrid coatings was studied.

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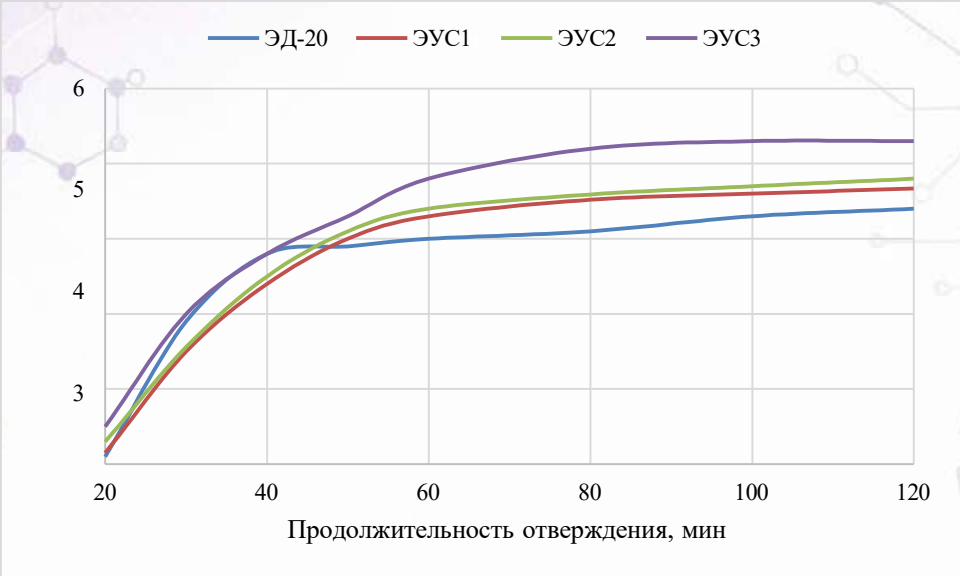


Figure 1. Dependence of the adhesive strength of coatings (ASC) on the curing time at temperature 120 °C

As the curves in the diagram show, with the content of GUS in the epoxy oligomer, a decrease in the adhesive strength is observed at the initial moment of curing. Probably, at such concentrations of the modifier, a sufficient number of chemical bonds are not formed in the hybrid coating to form an additional cross-linked structure. Increasing the KUS:ED-20 ratio to 15:85 causes an increase in the adhesive strength by 20%. The obtained results suggest that with an increase in the proportion of urethane bonds, the adhesive strength of the epoxy matrix increases. However, increasing the amount of the GUS modifying additive to 30% significantly reduces the strength, which is associated with an insufficiency of epoxy groups to form a cross-linked structure during curing. The epoxy number of such a hybrid oligomer is 6.84%, and the epoxy equivalent value is 617.3 g/mol. In this case, the required calculated amount of hardener decreases to 13.7 g/100 g. The system of this hybrid resin hardens for quite a long time (more than 2 hours), and the adhesive strength decreases by more than 2 times compared to the EUS3 sample and has lower values than the original ED-20. Probably, the decrease in adhesive strength is mainly due to a decrease in the molecular weight of the cured coating, since other factors, such as the number of OH groups in the hybrid composite, are greater compared to the EUS3 sample.

A study of the effect of curing temperature on the adhesive strength of coatings showed that increasing the temperature accelerates the curing process. Increasing the temperature from 120 to 150 °C reduces the curing time from 90 to 30 minutes.

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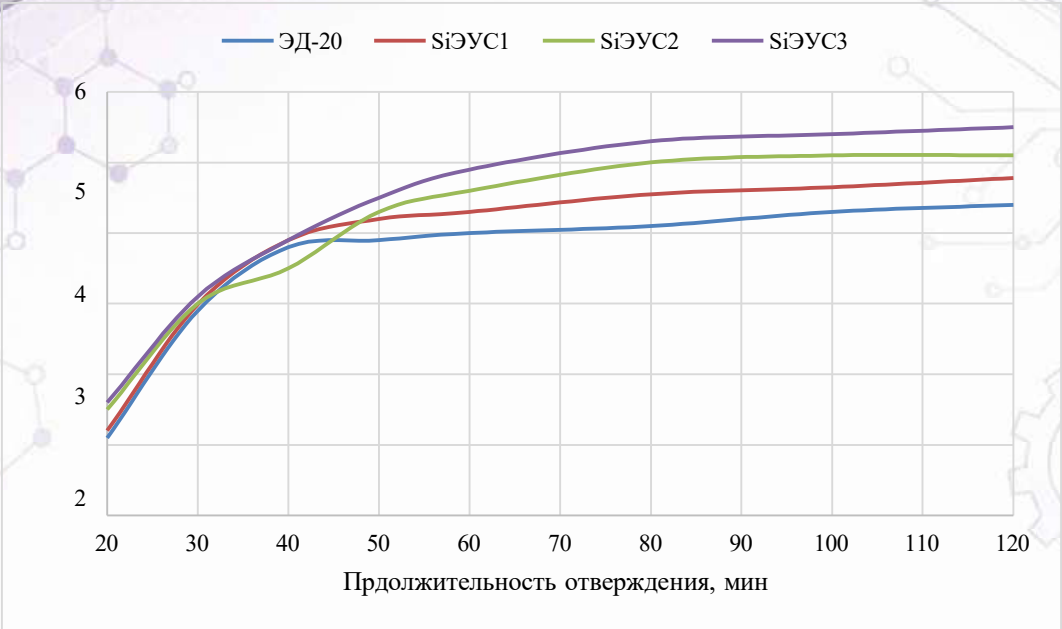


Figure 2. Dependence of the adhesive strength of coatings (SiEUS) on the curing time at a temperature of 120 °C

The strength of SiEUS samples across all temperature ranges and curing times is virtually identical to that of EUS samples. However, increasing the concentration of CUS in the reaction system to 30% does not cause a significant decrease in adhesive strength, as is the case with HUS. This is likely due to the participation of Si-O bonds in the formation of the network structure of the hybrid coating.

However, these systems are characterized by increased tensile strength compared to EUS. It is likely that the Si-O bonds in the epoxy matrix act as a plasticizer, thereby increasing tensile strength. The plasticizing effect is typically associated with the formation of new chemical bonds and additional structures.

Probably, in addition to an increase in the proportion of polar parts of molecules as a result of modification with selected modifiers, there is an increase in the number of hydrogen bonds, which contribute to the formation of a physical network that improves to some extent the deformation-strength characteristics, heat resistance and adhesion on various surfaces.

CONCLUSION.

Thus, the study of the adhesion strength of coatings on a steel surface showed improved values for this indicator for modified epoxy oligomers. This is probably due to a change in the nature of intermolecular interactions. The strength of SiEUS samples in all temperature ranges and the curing time are almost the same as the characteristics of the EUS sample. However, an increase in the concentration of KUS in the reaction system to 30% does not cause a significant decrease in adhesion strength, as in the case of HUS. This is probably due to the participation of Si-O bonds in the formation of the network structure of the hybrid

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coating.

BIBLIOGRAPHY

1. Антикоррозионные покрытия для нефтепроводов / К.С. Надиров, А.А. Есентаева, Г.Ж. Биббетова, М.К. Жан- тасов // Нефть и газ. – 2020. – № 2. – С. 109–119.
2. Ерофеев В.Т. Полиэфирные полимербетоны каркасной структуры: Автореф. дис. … канд. техн. наук. – Харь- ков, 1983. – 23 с.
3. Жарин Д.Е. Влияние полиизоцианата на физико механические свойства эпоксидных композитов // Пласти- ческие массы. – 2002. – № 7. – С. 38–41.
4. Оптимальные дисперсность и количество наполнителей для полимербетонов, клеев и мастик / В.И. Солома- тов, Е.Д. Яхнин, Н.Д. Симонов-Емельянов // Строит. материалы. – 1971. – № 12. – С. 24.
5. Снижение адгезионной способности твердых поверхностей / А.Я. Королев, П.В. Давыдов, Л.М. Виноградова // Адгезия полимеров. – М., 1963. – С. 3–11.
6. Absoatov Yu., Khalikov A., Akbarov X. Synthesis of hybrid epoxyurethane coatings and their physicochemical char- acteristics // Scientific Journal of Mechanics and Technology. – 2021. – Vol. 3. – P. 87–93.
7. Afzal A., Siddiqi H.M. A comprehensive study of the bicontinuous epoxy – silica hybrid polymers: I. Synthesis, characterization and glass transition // Polymer. – 2011. – Vol. 52. – P. 13450–13455.
8. Chauhan D.S., Saji V.S. Heterocyclic Organic Corrosion Inhibitors: Principles and Applications. – Elsevier, 2020. –P. 298.
9. Hsieh K.H., Han J.L. Graft interpenetrating polymer networks of polyurethane and epoxy. I. Mechanical behavior //
10. J. Polym. Sci., Part B, Polym. Physics. – 1990. – Vol. 28, № 5. – P. 623–630.
11. Mazumder M.A.J., Sheardown H., Al-Ahmed A. Functional Polymers. – Springer International Publishing, 2019. – P. 1178.
12. Mobin M., Shabnam H. Corrosion Behavior of Mild Steel and SS 304L in Presence of Dissolved Copper // Journal of Minerals and Materials Characterization and Engineering. – 2010. – Vol. 9, № 12. – P. 1113–1130.
13. Park S.J., Jin J.S. Energetic studies on epoxy–polyurethane interpenetrating polymer networks // J. Appl. Polym. Sci. – 2001. – Vol. 82, № 3. – P. 775–780.
14. Raymond M.P., Bui V.T. Epoxy/castor oil graft interpenetrating polymer networks // J. Appl. Polym. Sci. – 1998. – Vol. 70, № 9. – P. 1649–1659.

ISSN 3030-3907