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QUALITATIVE ANALYSIS OF AROMATIC OXIDE COMPOUNDS

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Abstract: The article presents a qualitative analysis of benzene-based oxycompounds. The most suitable option of qualitative analysis is selected. Also, a modern physico-chemical research method - infrared spectroscopic analysis - is presented for qualitatively distinguishing benzene series oxycompounds from each other, and the characteristic absorption spectra were determined as a result of spectral analysis.

Key words: phenol, resorcinol, hydroquinone, absorption spectrum, vibration frequency, infrared spectroscopy.

In the middle of the 19th century, hydroquinone was widely used as an antiseptic, but with the development of more effective medicinal substances, it was no longer used in medicine. Hydroquinone has received renewed attention in the last decade due to its ability to stimulate melanin production in skin cells, which can be used to treat hyperpigmentation. Hydroquinone differs from other phenols in terms of properties and uses[1,2].

Hydroquinone (1,4 dihydroxybenzene), paradioxybenzene, C6H4(OH)2 — organic compound, diatomic phenol, colorless crystalline substance. It dissolves well in hot water, alcohol, ether, poorly in benzene. An aqueous solution of hydroquinone oxidizes in air and turns brown, oxidation is accelerated in an alkaline environment. When oxidized, quinhydrone and paraquinone are formed. Because hydroquinone is a

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strong reducing agent, it can reduce feling liquid in the cold. Hydroquinone was first obtained from quinone in 1844 by the German chemist F. Vöhler. Hydroquinone is used in photography, as an antioxidant, as a semi-raw material in the organic dyes industry, and in analytical chemistry for the determination of various elements and compounds [3,4].

Usually, the change in color is the main criterion when using a qualitative reaction for substances. A number of reagents with qualitative reactions for hydroquinone are reported in the literature. Among them, some of the most common reagents and their effect on color change are listed in Table 1.

Table 1

Some qualitative reactions for hydroquinone

Reactive	Result	Explanation
$FeCl_3$	The green color changes to yellow	-

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Bromine water	White precipitate forms	The reaction is carried out in an alkaline environment
Nessler's reagent	It is painted black	The reaction is carried out on filter paper
Ortho-phthalaldehyde	Purple colored solution	The color will appear in a few minutes
Para-phthalaldehyde	The solution is colored brown	The color will appear in a few minutes
Phloroglucin	The color of the solution is orange-red	The intensity of the color depends on the hydroquinone concentration

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Sodium nitrite	Yellow solution	The yellow color of the solution is observed when heated. The solution darkens when 15% sodium hydroxide solution is added
Phosphorous molybdenum acid	Blue colored solution	The reaction is carried out in water or ether

The table shows that several color reactions can be proposed for the determination of hydroquinone. However, not all of them react with only phenolic quality, as they are typical of many compounds of phenolic nature. It should be noted that a qualitative reaction with a solution of ferric chloride allows the separation of hydroquinone from various compounds. In addition, these reactions require reagents that do not react under normal conditions, which complicates the application of these methods in substance analysis. Therefore, modern physico-chemical analyzes are used in the qualitative determination of hydroquinone [5].

Provides comparative information on methods of standardization of substances obtained as a result of analysis using the infrared spectroscopy method for the determination of pure substances [6,7].

Infrared spectroscopy (IR) is a branch that studies the interaction of infrared light with matter. When infrared light passes through a substance, absorption spectra (peaks) appear due to the vibrational motion of molecules or the motion of individual parts in the molecule. A weakening of the light intensity transmitted through the sample is observed. But absorption does not occur in the entire spectrum of radiation, but only in wavelengths whose energy corresponds to the vibrational energy of the studied

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molecules. The wavelengths (or frequencies) at which maximum absorption of IR radiation is observed can indicate the presence of certain functional groups and other moieties in the sample molecules. Usually, there are a number of absorption peaks in the infrared spectrum, and the structure of the studied sample can be concluded from their position and relative intensity. A database of IR spectra of certain substances has been created, which allows to compare with the spectrum of new synthesized substances, to determine new bonds and the structure of the substance molecule [8,9,10].

From the analysis of the IR spectrum, it is possible to determine the presence of a hydrogen bond, a change in the valence angle as a result of intermolecular and intramolecular interaction. For a comparative analysis of the IR spectrum, it was compared with the IR of benzene-based oxycompounds (Fig. 1)[5,6].

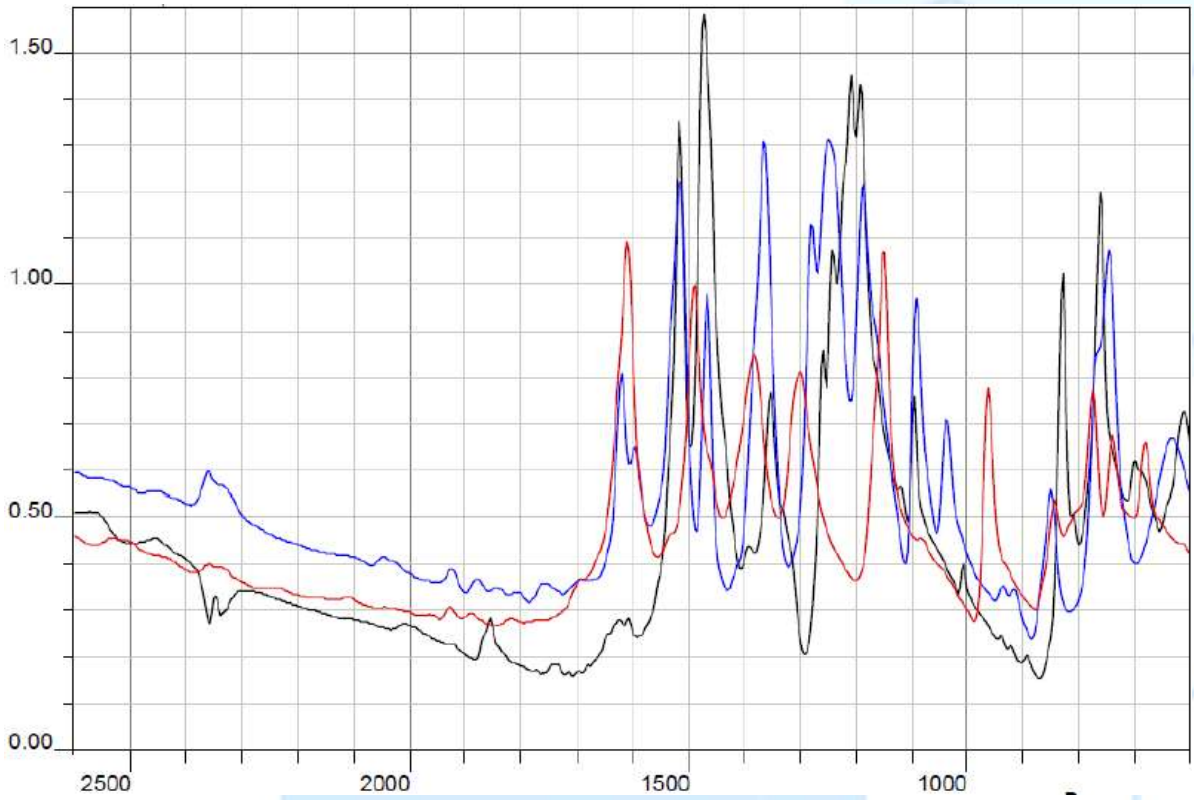

Figure 1. IR spectra of hydroquinone (black), resorcinol (red) and pyrocatechin (blue)

Comparison of the IR spectra of different samples of hydroquinone with the spectra of pyrocatechin and resorcin made it possible to identify the most important

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absorption bands that allow to distinguish these compounds[11,12]. The main different absorption spectra in them are observed in the regions of 610, 828 and 1855 sm^{-1}, and these absorption lines characterize only hydroquinone. Also, IR spectroscopy data showed that absorption spectra of C-H bonds are observed in the 760, 1097 sm^{-1} regions due to the shift of different electron density in the carbon atoms of the benzene nucleus. Absorption spectra characterizing C-O bonds show an absorption spectrum in the region of 1197-1205 sm^{-1} in the form of a doublet. The absorption spectrum in the region of 1518 sm^{-1} represents the C=C bond located in the benzene nucleus[13,14].

Thus, this IR spectroscopic analysis method is used to confirm the authenticity of the hydroquinone substance and to distinguish it from other oxycompounds. This makes it possible to widely use IR spectroscopy in the qualitative determination of substances.

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