

## ABSTRACT

of a PhD dissertation on a speciality 6D072000 – Chemical technology of inorganic substances

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### **Research of technological bases of glyphosate synthesis with application of local raw materials**

**Actuality of the thesis.** At the present stage of industrial innovative development of economy of the Republic of Kazakhstan, concentration and specialization of production a role of pesticides as agents for weeding, protection of agricultural crops and plants against illnesses, and also seed treatment essentially increases and becomes an urgent problem. These questions have been considered in Message of President N.A.Nazarbayev for 2013-2020 on improvement of well-being of the Kazakhstan people.

Many inorganic compounds are widely applied in various branches of economy all over the world as pesticides, insecticides, herbicides, phytohormones, fungicides and other preparations. One of the most important classes of modern pesticides found wide application in agricultural and farm economy sectors includes inorganic and organic phosphorus compounds containing various physiologically active substances possessing selective action.

Glyphosate is one of such the herbicides of selective and continuous action.

Glyphosate may be used at weeding and growth suppression of annual and perennial weeds, which did not subjected to removal for many years. This task demands special means that does the problem actual.

For solution of the assigned tasks in a special economic zone “Chemical Park “Taraz” construction of a high-tech and competitive chemical production is realized. According to the construction programme output of agrochemical products by 2018 should make 10000 tonnes of a technical glyphosate. In addition, it is supposed that the production will produce for small-scale and average-scale business such chemical compounds as formulate, being a herbicide, and also fungicides and insectofungicides.

This problem is also actual one from the point of view of reduction of material costs at the expense of application of production phosphorus-containing wastes and improvement of the environmental situation of the south industrial region of the Republic of Kazakhstan.

It is necessary to notice, that weed plants are more viable than cultivated ones in many times; they quickly enough breed. The majority of them give for a season a considerable quantity of seeds in comparison with cultivated crops.

Hazardous organisms damage not only to a human and live organisms surrounding us, but also destroy various metal and nonmetallic materials, plastics, caoutchouc, glass, rubber, natural and synthetic fibers and even petrochemical products. It is known, that annually from 2 to 5% of products made from synthetic

materials outwear as a result of destruction by various harmful organisms. More than 40% of all the damages are caused by the microorganisms, which vital activity is a reason for change of a hydrocarbon composition of liquid fuel, formation of mucus-like products and emulsions, which block filters and pumps of engines, worsen properties of lubricants, changing their physical and chemical characteristics and surface tension, destroy wood, synthetic polymers, etc.

In connection with the above stated researches on development of chemical substances for plant protection and hazardous microorganism control get a huge urgency at present. Among numerous modern means and methods of plant protection chemical methods have the greatest value.

**The thesis purpose** consists in development of a glyphosate production technology from diethanolamine and the phosphorus extracted from phosphorus-containing wastes – ammophos return and phosphoric slime.

**For achievement of the assigned task following scientific problems have been formulated and solved:**

- assessment of a possibility of phosphorus extraction from phosphorus-containing wastes – ammophos return and a phosphorus-containing slime;
- studying a possibility of obtaining glyphosate out of diethanolamine and the phosphorus extracted from phosphorus-containing wastes;
- determination of key parameters of a phosphorus extraction process from a phosphorus-containing slime by a hydroclassification method;
- studying a phosphorous and phosphoric acids production process out of ammophos return after its thermal decomposition and a phosphoric slime after its hydroclassification;
- determination of optimum technological parameters of a glyphosate production process from inorganic and organic compounds in the presence of catalysts on the basis of sodium hydroxide and iron sulphide;
- determination of thermodynamic probability of obtaining iminodiacetonitrile with application of the phosphorus extracted from a phosphorus-containing slime;
- technical-ecological analysis of glyphosate production technologies with application of different phosphorus-containing wastes and choice of an optimal option.

**The investigation object and subject:** Objects of the investigation are experimental installations for studying a glyphosate production technology and also extraction processes of necessary components from phosphorus-containing wastes.

A subject of the study is the systems formed at obtaining glyphosate from 2,5-diketopiperazine, formaldehyde, diethanolamine and the phosphorus produced from ammophos return or a phosphoric slime in the presence of catalysts.

**Scientific novelty of the thesis:**

- physical and chemical bases of a glyphosate production technology from 2,5-diketopiperazine, formaldehyde, diethanolamine and the phosphorus extracted from ammophos return and a phosphoric slime have been developed;

- chemism of the glyphosate production process and its basic thermodynamic regularities have been established;
- optimum technological parameters of the glyphosate production process have been revealed and determined.

**Practical value** of results of the theoretical and experimental investigations consists in:

- development of a manufacturing scheme of glyphosate production from various inorganic (hydrogen peroxide, phosphorous and phosphoric acids on the basis of a phosphoric slime) and organic (diethanolamine, formaldehyde) compounds in the presence of catalysts;
- development of guidelines for choice of key parameters of technological processes of glyphosate manufacture from 2,5-diketopiperazine, formaldehyde, diethanolamine and the phosphorus extracted out of ammophos return and a phosphoric slime;
- development of methodical instructions on studying a glyphosate production technology from various inorganic and organic compounds for application in the educational process.

**Realization of the work** – it can be used at manufacture of glyphosate applied to weeding in agrarian and household sectors of economy, and also in the educational process at studying a discipline “Technology of herbicides” and implementation of laboratory researches.

**Reliability of the thesis results** is confirmed by use of known and approved experimental techniques, modern devices and measuring methods. Scientific propositions and conclusions of the dissertation are based on fundamental laws of chemistry, chemical thermodynamics, physical chemistry and estimated by results of own researches and known literary data.

**Basic provisions submitted to the defense:**

- chemism of obtaining glyphosate on the basis of a chemical reaction of diethanolamine and formaldehyde with the phosphorus extracted from a phosphoric slime in the presence of hydrogen peroxide and inorganic catalysts;
- the developed technological scheme of glyphosate production from inorganic and organic compounds;
- optimum parameters of a glyphosate production process out of inorganic and organic compounds in the presence of catalysts.

**Connection with a research plan.** The present work has been carried out according to a scientific research plan of M. Auezov South Kazakhstan State University Б-16-02-03 “Research on creation of alternative innovative technologies of raw materials concentration and manufacture of inorganic products from natural ore mineral resources and technogenic wastes of a phosphorus branch of chemical industry” and also the Government program of agricultural development of the Republic of Kazakhstan for 2017-2021.

**Approbation of the work.** Results of the research have been stated and discussed at international scientific conferences “Current trends of science and technology development” (Belgorod, the Russian Federation), “Way of Kazakhstan: 25 years of peace and creation with the leader of the nation” devoted

to 25<sup>th</sup> anniversary of independence of the Republic of Kazakhstan (Shymkent, RK), “International Conference of Industrial Technologies and Engineering” (Shymkent, RK).

**Personal contribution of the author** consists in:

- development of the glyphosate production technology from inorganic and organic compounds in the presence of catalysts;
- personal participation in implementation of calculations and experimental investigations;
- formulation of conclusions of the dissertation;
- personal participation in approbation of the research results.

**Publications.** Main results of the dissertation investigation have been published in 10 scientific works including 1 article in a journal listed in the Scopus database/Web of Science (Thomson Reuters), 3 articles in journals recommended by Control Committee in education and science of Ministry of Education and Science of the Republic of Kazakhstan, 3 works in materials of international conferences including one foreign conference, 2 articles in foreign scientific journals; also 1 study guide has been published.

**The thesis structure and volume.** The thesis contains 103 pages including 23 figures, 14 tables and a bibliographic list including 153 references.