

## **Technical proposal**

for delivery of the control system of magnesia addition preparation process  
in the ammonium nitrate production

The control system of preparation process of magnesia addition for the ammonium nitrate production is a set of devices that provides automatic control of the neutralization process of nitric acid by the magnesia addition.

The purpose of this development is the creation of a continuous and constant monitoring (indication) of excess nitric acid and magnesia addition in the technological solution of the following composition:

- nitric acid – 0-35%;
- magnesium nitrate – 0-45%;
- water – other.

The system is designed to control the content of excess nitric acid, to determine the end point of neutralization and the formation and precipitation of iron hydroxide to optimize the magnesia addition preparation.

Using the system makes it possible to control the process of magnesia addition preparation, visualize information about the process, save and view the history of the process.

The control system of magnesia addition preparation was implemented at JSC "Azot", Cherkassy, JSC "Energy Invest", Rustavi.

At the present time we design, manufacture and implement control systems of technological environments and processes in the chemical industry.

These systems are exploited in Ukraine, as well as in the foreign countries in the production of ammonium nitrate, sodium cyanide, nitrite and nitrate salts, hydroxylamine. At the same time the control of excess nitric and sulfuric acids in the concentration range from 0 to 20 % is carried out.

### **Delivery of the system for the two devices of magnesia addition preparation includes:**

- equip the system with the single-board industrial computer with input – output board and two potentiostats, two spark protection blocks and four concentration sensors(including reserve);
- documentation delivery for the input units of sensors;

- installation supervision of the input units of sensors;
- installation of sensors for the system, system adjustment;
- technical documentation delivery;
- user guide delivery;
- training of service personnel;
- carrying out warranty tests, delivery of the system into service.

Manufacture and installation of input units of sensors, installation of the instrument part of the system, the laying of cable lines is performed by the Customer.

The warranty period of exploitation of the system by the manufacturer - 1 year from the date of putting into operation. During the warranty period, Contractor provides free repair of the system and deliver new versions of the software.

The Contractor shall perform the post warranty service of the system.

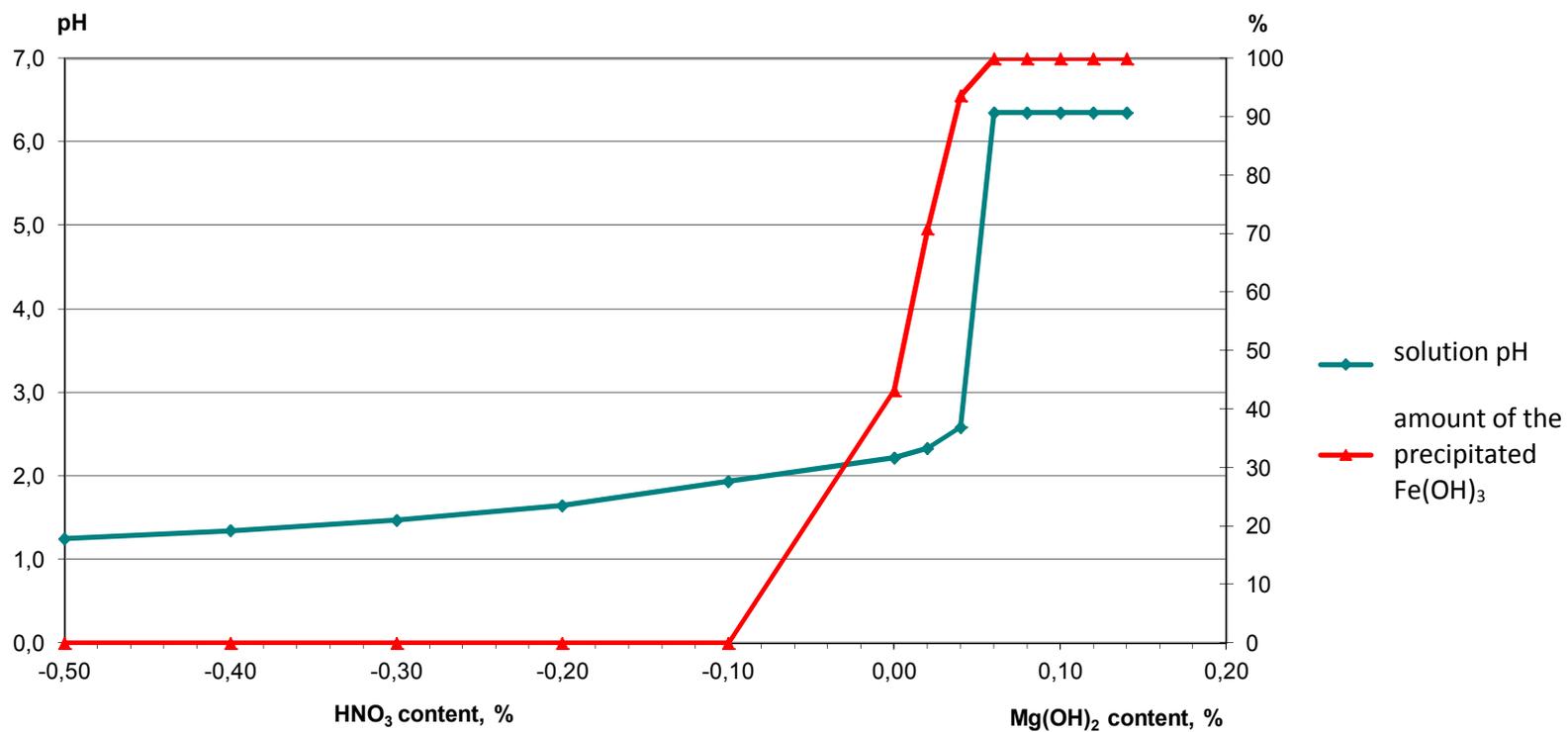
The proposed system is implemented during 4 months.

## **Attachment 1**

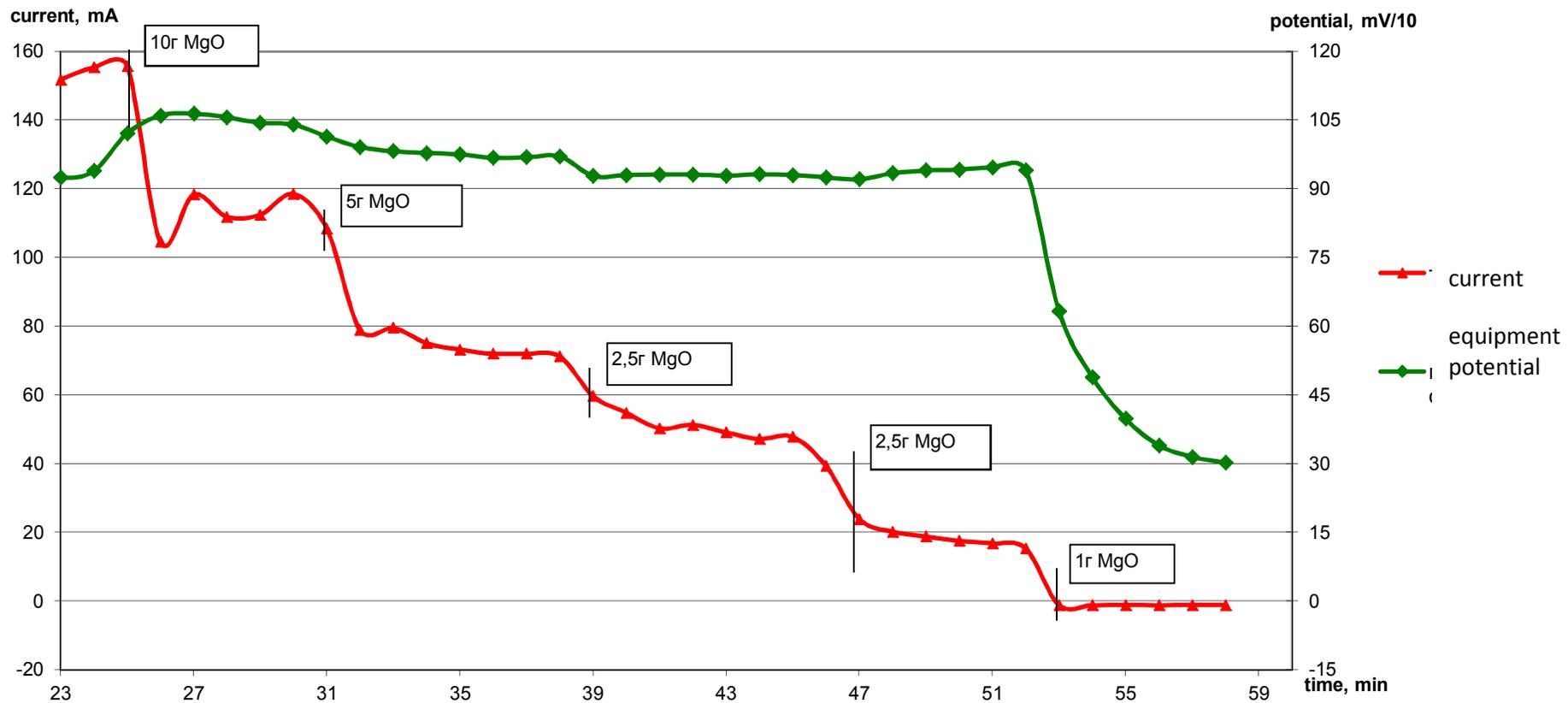
## **Control of magnesia addition preparation process by electrochemical methods**

Calculations and laboratory research has shown that during the neutralization of 35% nitric acid by the magnesia addition precipitation of  $\text{Fe}(\text{OH})_3$  is the result of displacement of pH of the solution from 2 to 6.3, and almost 100% precipitation of  $\text{Fe}(\text{OH})_3$  happens when a pH is more than 6.0 (fig. 1). In this case there is a dependence of the oxidation-reduction current on the amount of excess nitric acid in solution, and happens a potential jump at the end of the neutralization and precipitation (fig. 2), which allows to control the process.

**Fig.1. The dependence of the pH of the solution and the amount of the precipitated  $\text{Fe}(\text{OH})_3$  of the additions of  $\text{Mg}(\text{OH})_2$  in an aqueous solution of 40%  $\text{Mg}(\text{NO}_3)_2$  with 0,03%  $\text{Fe}^{3+}$  at 90 ° C**



**Fig.2. Change of the current value on the indicator electrode and the equipment potential in time, according to addition type of MgO in 35% HNO<sub>3</sub> at 90 ° C, the mixing**



## **Attachment 2**

## Recommendations for the exploitation of the system of control of magnesia addition preparation process

The magnesia addition preparation process is demonstrated on a picture (a view of computer screen):

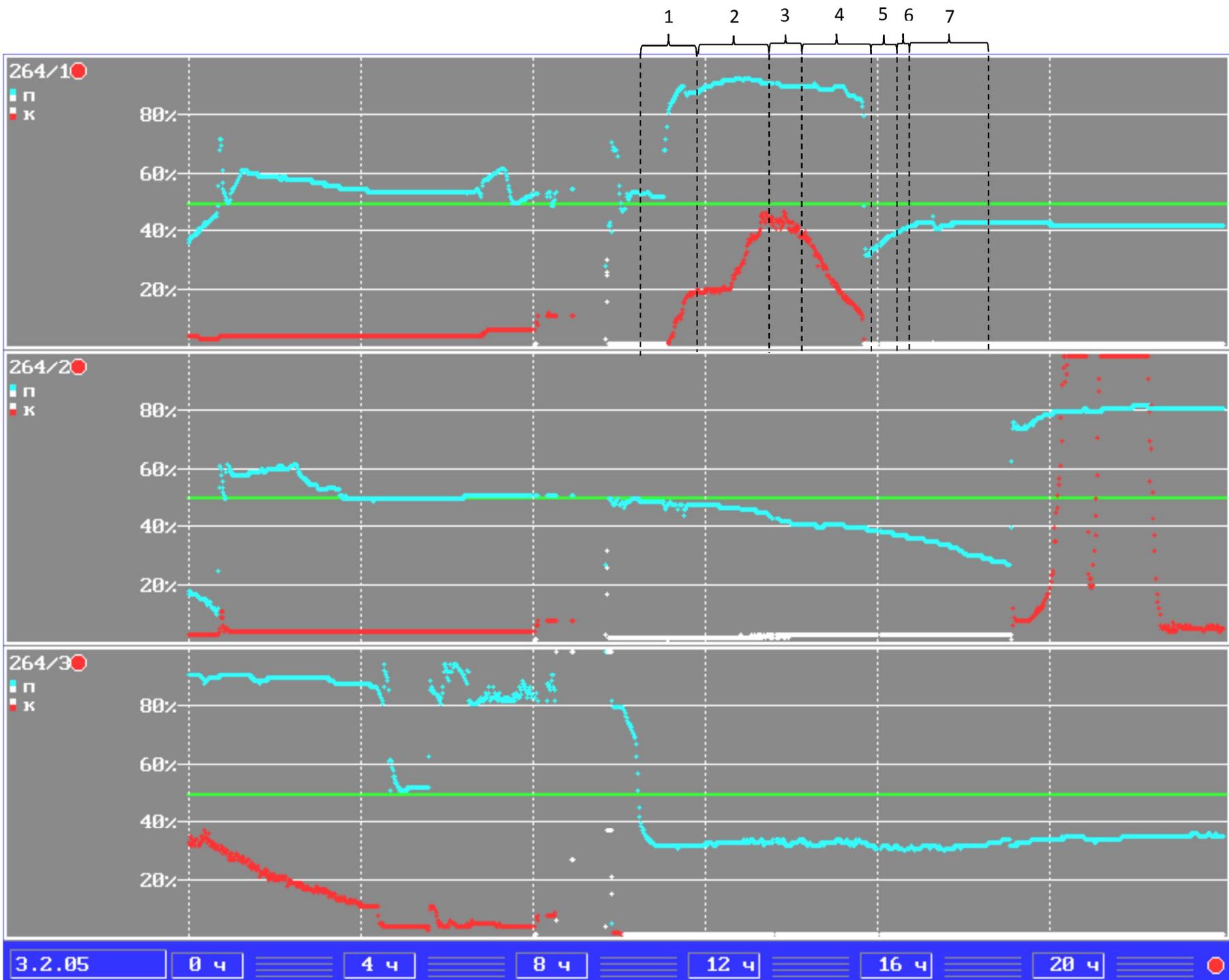
1. Filling in the neutralizer with the water ("potential" is set about 50%, "the concentration of acid" about 0%).
2. Adding acid in the neutralizer ("potential" is set about 85-95%, "the concentration of acid" about 20%).
3. Adding the first reagent addition, the beginning of the neutralization process ("potential" is unchanged, indications of "the concentration of acid" rise up to 40-50% as a result of solution temperature increasing to 80°C).
4. With further reagent additions the "potential" changes a little, indications "of acid concentration" decrease proportionally.
5. When "the acid concentration" goes to zero, indications of "potential" are beginning to decrease. The amount of addition should be reduced.
6. In the area of stoichiometric ratio "the acid concentration" goes to zero, and the small amount of addition (10-50 kg) causes a "potential" jump.
7. Due to the fact that too big addition (500 kg) was added in the area of stoichiometric ratio, the resulting solution was neutralized with acid, and the "potential" increased from 30 to 40%.

Indication of the acid concentration allows to roughly judge about the neutralization process, and the indication of the potential allows to determine the time of the stoichiometric balance achievement accurately.

When approaching the area of the stoichiometric balance, amount of reagent addition should be reduced.

So, if for carrying out the neutralization process is necessary about 4 tons of magnesia addition in general, then for transition through the stoichiometric balance is necessary only 10 - 50 kg of magnesium addition, and the pH is 6.5 - 6.8 in this case.

Potential change for 10% corresponds to 1 unit of pH approximately.



## **Attachment 3**

“Утверждаю”

Ген. директор

(Президент)

АО «Энерджи инвест»



**Акт**  
**сдачи-приемки системы контроля процесса приготовления магнизиальной добавки в**  
**производстве аммиачной селитры**  
**контракт №268/12-05/06**  
**АО «Энерджи Инвест» г. Рустави, 07 февраля 2008 г.**

В период с 31.01.2008 по 07.02.2008 были выполнены следующие виды работ:

1. авторский надзор за установкой датчиков;
2. авторский надзор за монтажом приборной части (потенциостатов, барьеров искрозащиты, промышленного компьютера);
3. авторский надзор за подключение сигнальных кабелей от датчиков;
4. тестирование сигналов, выдаваемых системой на сигнализацию, регистрацию и на датчики концентрации;
5. тестирование сигналов, поступающих от датчиков концентрации;
6. наладка системы;
7. обучение обслуживающего персонала;
8. гарантийные испытания.

Результаты испытаний:

Система контроля в течение всего времени испытаний обеспечивала контроль процесса приготовления магнизиальной добавки в реакторах поз.1 – поз.4., отображение динамики изменения концентрации азотной кислоты в процессе приготовления магнизиальной добавки в реакторах поз.1 – поз.4. и сигнализацию окончания процесса.

Выводы:

1. Работы проведены в соответствие с контрактом №268/12-05/06.
2. Пуско-наладочные работы проведены в полном объеме.
3. По результатам испытаний, показания системы контроля процесса приготовления магнизиальной добавки в производстве аммиачной селитры удовлетворяют техническим требованиям на систему.

Система контроля процесса приготовления магнизиальной добавки в производстве аммиачной селитры сдана в эксплуатацию.

От ГП «ИАП»

Руководитель группы внедрения  
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“Утверждаю”

Bx-259-3

Главный инженер

23.03.05

ЗАО «Куйбышевазот»

Отарков А.А.

  
« 9 » 03

2005 г.

## Act

### of delivery and acceptance of the system of control and regulation of neutralization processes in the production of ammonium nitrate

contract 643/289-04/05

Toliatti, 9.03.2005

In the period from 24.02.2005 to 03.09.2005 were performed the following works:

1. Supervision of installation of sensors;
2. Installation of the instrument (potentiostat, spark protection barriers, terminals, industrial PCs);
3. Connection of signal cables to the sensors and regulating the feeder of ammonia and nitric acid;
4. Testing of signals issued by the system on regulating feeder of ammonia, nitric acid and the concentration sensors;
5. Testing the signals from concentration sensors;
6. Adjustment of the system;
7. Training of service personnel;
8. Verification of the measuring channels;
9. Warranty tests.

#### Results of tests:

1. Control and monitoring system during all the time of tests provided monitoring and display of the dynamics of the neutralization process by parameters:

in the ИТН devices (pos. 13/1, 13/2) - the potential of equipment in the reaction zone and the concentration of nitric acid in the stream of ammonium nitrate at the exit;

in the scrubbers (pos. 201, 250) - the concentration of nitric acid in the stream of ammonium nitrate at the exit;

in the neutralizer (pos. 17) - the concentration of ammonia in a stream of of ammonium nitrate at the exit;

in a container of melt, applied to the granulation (pos. 173) - the concentration of ammonia in of ammonium nitrate melt.

2. During the tests was carried out the refinement of the task on regulation and selection of coefficients in the proportional and integral component in the law of regulation.

3. Control and monitoring system provides the regulation of neutralization process and maintenance in the range of routine values in accordance with the task of regulation:

in the ITH devices (pos. 13/1, 13/2) - the potential of equipment in the reaction zone and the concentration of nitric acid in the stream of ammonium nitrate at the exit;

in the scrubbers (pos. 201, 250) - the concentration of nitric acid in the stream of ammonium nitrate at the exit;

in the neutralizer (pos. 17) - the concentration of ammonia in a stream of of ammonium nitrate at the exit;

in a container of melt, applied to the granulation (pos. 173) - the concentration of ammonia in of ammonium nitrate melt.

4. Carried verification of the measuring channels (pos. 13/1, 13/2, 201, 250, 17) showed that the metrological characteristics meet the technical requirements.

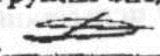
#### Conclusion:

1. Works was performed according to the contract № 643/289-04/05.
2. Installation and commissioning works was fully carried out.
3. According to the results of tests indications of control and regulation system of neutralization processes in the production of ammonium nitrate met the technical requirements of the system.
4. For improving the operation of system we recommend to perform actions in accordance with Attachment 1.

Control and regulation system of neutralization processes in the production of ammonium nitrate was put into operation.

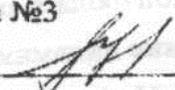
От ГНИПИ «Химтехнология»

Руководитель группы внедрения

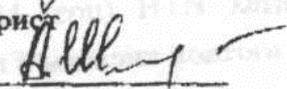
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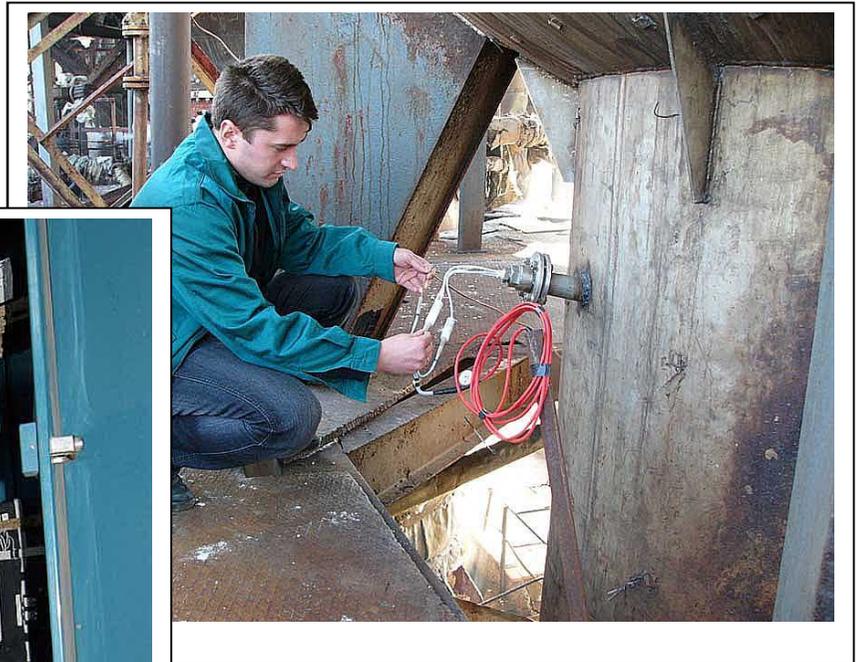
От ЗАО «Куйбышевазот»

Начальник цеха №3

Будяк А.В. 

Главный приборист

Алексеев В.В. 



**View of:**

- sensor;
- instrument part;
- operator's workplace.