

THE SCIENTIFIC EXPLANATION OF THE TECHNOLOGIES TO GET PURE PALLADIUM POWDER FROM RECYCLED ELECTROLYTES

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Abstract: in this article, the investigation method of getting palladium by melting abandoned electrolytic solutions with aqua regia ($\text{HCl} \cdot \text{HNO}_3$) is highlighted. Also, the investigation methods of selective drowning to purify from detrimental impurities to get palladium powder, factors that impact on technological processes, the definition of utilized new technologies and equipments are explained. It's impossible to imagine modern industry without palladium. It is used widely in the electronics and chemical industry to make accelerators and sturdier chemical equipment.

Keywords: palladium, cinder, ammonium chloride, the waste of electrolytic solution, palladium powder, selective drowning, aqua regia solution, filtration, washing, burning.

НАУЧНОЕ ОБОСНОВАНИЕ ТЕХНОЛОГИИ ПОЛУЧЕНИЯ ЧИСТОГО ПОРОШКА ПАЛЛАДИЯ ИЗ ТЕХНОГЕННЫХ ЭЛЕКТРОЛИТОВ

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Аннотация: в статье освещается метод исследования получения палладия путем плавления заброшенных электролитических растворов с царской водкой ($\text{HCl} * \text{HNO}_3$). Также разъясняются методы исследования селективного утопления для очистки от вредных примесей для получения порошка палладия, факторы, влияющие на технологические процессы, определение используемых новых технологий и оборудования. Современную промышленность невозможно представить без палладия. Он широко используется в электронной и химической промышленности для изготовления ускорителей и более прочного химического оборудования.

Ключевые слова: палладий, шлак, хлорид аммония, отходы электролитического раствора, порошок палладия, селективное утопление, раствор царской водки, фильтрация, промывка, сжигание.

The necessity of the research: Uzbekistan is considered a country that is full of raw materials. Nowadays there is a great demand for rare metals but their expansion on the earth is the lest. Immediately introducing modern innovative technologies to the economic, social, and other branches by using scientific and technical achievements comprehensively, is considered a significant necessity of the intensive development of the Republic of Uzbekistan. And “map” to carry out the strategy, approved the scales to develop the country innovatively, until the year 2030.

For this reason, by enhancing the production, extracting rare metals from ore has become a serious problem. The production and recycling of noble metals are considered accelerators of the technical industry, academic A.E. Fersman named them “vitamins of industry”.

The point of the research: The points of the research are abandoned electrolytic sludge and solutions in NMMC and AMMC. The method of the research consists of extraction scheme and technologies to get palladium powder from abandoned electrolytes with brand new technologies.

Colossal palladium mines are located in Russia (Norilsk, Talnakh), Africa (Transvaal), Canada, Australia and in Columbia. The largest palladium producer is “Nornikel” (it’s share is 40% of worldwide production).

It’s impossible to imagine modern industry without palladium. It is used widely in the electronics and chemical industry to make accelerators and sturdier chemical equipment.

The method of forming palladium from platinum-palladium chloride solution is known, it is based on drowning the salt hexa-chlorine-platinum ammonium, filtering palladium to get rid of impurities.

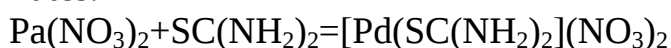
Main drawback of this method is the excessive amount of platinum in the palladium solution. Another discomfort it that, in the solution there is not only

excessive amounts of platinum, also, other metals are found in a large amounts and complication of the process of refining to get purified palladium.

The technology “Separating palladium from gold and silver refining room solutions” made by AMMC staff and researchers. Offering brand-new technic scheme is shown on the 1st picture, process 14. And it’s duration is 24-26 hours. In this process, it is possible to get 82 % palladium through 50 mg/liter waste (abandoned) solution.

The research spotlights melting platinum and palladium with aqua regia (HNO₃*HCl) completely, then using selective drowning or other ways to clean the solution from platinum and other impurities and getting purified palladium powder.

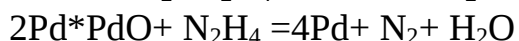
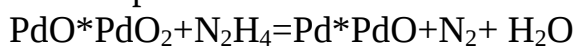
First of all, gold and silver are separated from red sludge came from cooper and nickel production, then electrolytic solutions which contain 50-200mg/liter palladium are mixed with thiourea solution in the mixing reactor within 15-30 minutes.



Palladium-thiourea complex compound is drowned until it contains 1500-2000grs palladium, then it is filtrated. And manipulated in water until it’s pH level gets 5. Dried under vacuum then sent to the incineration process. As a result, palladium-thiourea complex is decomposed to palladium oxides and gases.



Black palladium oxide scald is grinded and sent to hydrazine solution for restitution process.



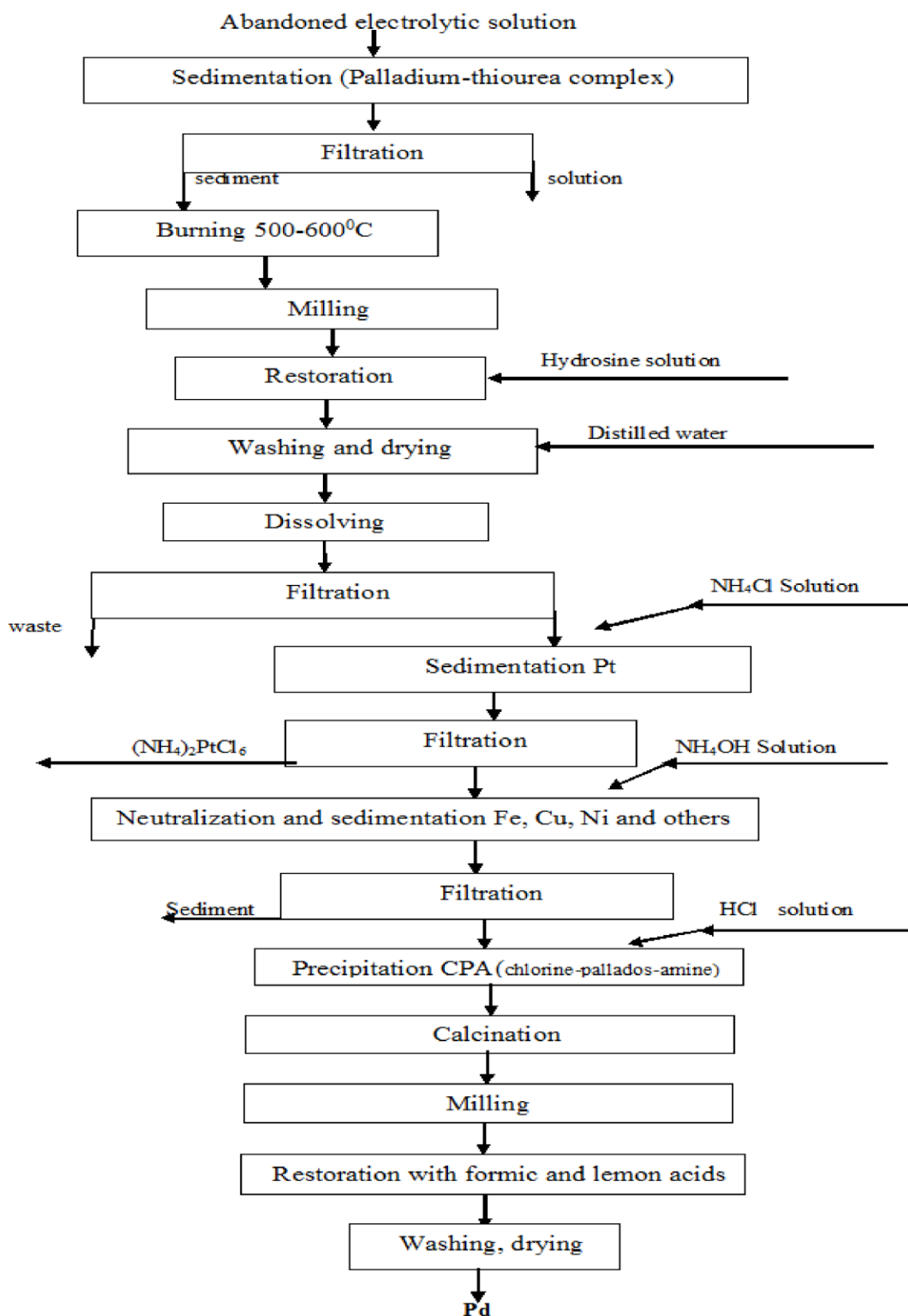
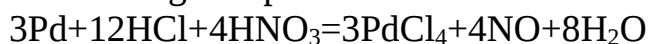


Fig. 1. Technic scheme of recycling palladium powder

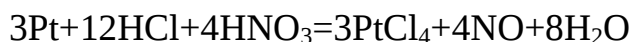
Reformed palladium product is washed with distilled water thoroughly, in order to get rid of hydrazine remnant and burnt under 100°C. Dried product is

dissolved in aqua regia solution. In this case, 2 liters of aqua regia is used to dissolve 100 grs of palladium.

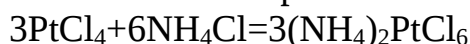


Dissolving process lasts 1-2 hours with regular heating and the amount of palladium makes up 50 grs/liter.

Due to the powerfulness of aqua regia solution, the metal platinum is also dissolved in the same time.

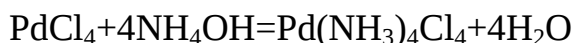


In order to drown platinum selectively, Ammonium chloride is added.

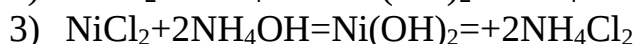
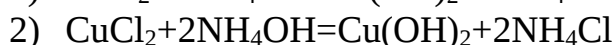
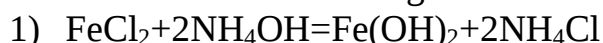


The advantage of learnt and used methods during the research is that, in order to purify palladium from unnecessary impurities, unique technic is prepared to remove each metal. Ammonium chloride gives chance to remove platinum, ammonium hydroxide is used to clean maximally from copper, nickel, iron. As a result we can get high quality purified palladium powder.

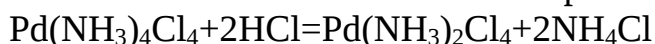
In consequence of adding ammonium hydroxide to palladium tetra-chloride, palladium stays in a pure statement in the solution, other metals sink due to hydroxide combination.



Extra metals sink according to below shown reactions.



Then to discard unnecessary sediments, solution is filtrated, trash is caught up, necessary compound stays in the solution. Palladium in the solution is drowned with chloride acid in chlorine-pallados-amine condition.



To get 100 grs palladium powder 1 liter of chloride acid is required. Condition is acidic, pH=1-2.

Appeared chlorine-pallados-amine is burnt under high temperature to get palladium metal.



Formed palladium powder saves very little amount of extra metals, in order to clean impurities, formic acid (HCOOH) and lemon acid ($(\text{HOOCCH}_2)_2\text{C}(\text{OH})\text{COOH}$) solutions are added. Palladium powder that is cleaned from impurities is washed with distilled water, dried and eventually 99,90% hallmark palladium powder is formed.

Offered technology helps to solve below given tasks:

1. Eases and improves the technology to get recycled palladium powder. Before used technology required 40-50 different processes and lasted up to 60-70 hours, also the technology was extremely complicated.

2. As a result of new technology, the level of separating metal from the solution increased from 60% to 82%.

3. The level of purity of recycled palladium powder is exceeded until 99,90%. The advantages of innovative technology are that:

Recycling high purity level palladium powder with low electricity usage, increasing production efficiency, saving chemical reagents and the chance of separating noble metals in a complex statement. According to the ecologic aspects, research method is harmless to the environment, the ways to dissolve appeared waste solutions in alkaline solution are completely studied. In AMMC's copper melting plant, the research of getting recycled palladium powder is investigated too many with with different dilution level solutions. And optimal regime is chosen. The compound of palladium powder that is formed through the research is shown in the table.

As a result of experiment, in favor of new offered technology, it is achieved to get 99,90% palladium powder which meets world standard. Main news of the technology are correctly utilization of technic scheme of dissolving in aqua regia solution and the usage of selective drowning to clean from impurities and uncomparability of lemon acid $((\text{HOOCCH}_2)_2\text{C}(\text{OH})\text{COOH})$ in the final cleaning process. As a result of using the technology widely, leads to achieve high economic efficiency due to separating extra valuable components.

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