Highly efficient titanium anodes with electrocatalytic coating of mixed oxides based on ruthenium, palladium and iridium for industrial disinfection of water with sodium hypochlorite

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Sodium hypochlorite is used as a safe alternative to chlorine in the disinfection of drinking water. Sodium hypochlorite is obtained by electrolysis of a solution of table salt or natural chloride-containing waters. The anode material has the greatest influence on the efficiency of electrolysis, electrical and electrochemical parameters, the economy of the process and its operating regulations, the design of devices and their durability. It is very important to choose the optimal coating with a long service life and high chlorine release ability. The most effective anode material is ruthenium titanium oxide anode, since it is this that allows one to achieve the highest concentration of hypochlorite (up to 9–10 g/l chlorine equivalent) with a high current yield of chlorine (60–70%). However, such anodes has a limited service life due to the irreversible loss of ruthenium oxide during anodic polarization. More effective are three-component anode coatings containing iridium (oxide-iridium ruthenium-titanium anodes), which increase corrosion resistance up to 8 times compared to ruthenium-type anodes. On the other hand, the cost of iridium is 7÷8 times higher than the cost of ruthenium, which significantly affects the economic aspects of using such anodes in the water disinfection industry with sodium hypochlorite. Palladium has a lower cost compared to iridium (3.5÷4 times) and at the same time is a highly active catalyst. The use of palladium as part of the electrocatalytic coating of anodes with partial replacement of iridium makes it possible to reduce the cost of such anodes and increase their efficiency in chlorine output over current without significantly reducing the corrosion resistance of such a multicomponent system. The addition of palladium oxides to mixed oxide electrodes causes an increase in catalytic activity due to a change in the ratio of oxygen and chlorine overpotentials. The possibility of the formation of oxides Pd_xO_y, at high current densities, having a high redox potential, leads to enhanced catalysis by the redox mechanism, as well as to an increase in the corrosion resistance of the electrode due to the protective effect of palladium in relation to titanium.

Figures

	Ru-Ir/Ti	RuPdIr/Ti
Specific consumption of electricity, kWh/kg of act.Cl.	3,6**	3,3
Service life, years	2,5	3*
The cost of the anode, USD/m^2	460	450

Table 1: Comparative features of developed Pd-based anode in comparison Ru-Ir - analogue