Dismantling of an electrolyzer cathode unit directly within the electrolyzer building using dismantling machines fitted with pneumatic and hydraulic hammers [1] is accompanied by formation of additional vibratory dynamic action over the background on neighboring electrolyzers. According to estimates, the additional load on a neighbor with dismantling of an electrolyzer with a impact breaking scheme for the cathode unit lining may exceed by a factor of 1.5 – 2.5 the overall background vibration load for the period of its operation between repairs under natural conditions. As a result of the impact action on a neighbor from the electrolyzer being repaired is a worsening of their lining condition, that finally may lead to early shutdown of an electrolyzer for major overhaul.

With an impact breaking scheme for a cathode unit of an electrolyzer development of additional vibration and dynamic loads in a neighboring electrolyzer is accompanied by the following:

- an increase in crack formation as a result of additional vibration on the lining;
- acceleration of diffusion and passage of molten aluminum within the cathode unit into the lining through cracks formed;
- disturbance of molten aluminum stability accompanied by excitation in the melt of surface vibrations at natural frequencies leading to a change in electrolysis regimes.

With the use of pneumatic and hydraulic hammers, apart from the main vibration frequency, determined by the natural frequency of the hammer operation, that is within the range $F = 6 – 15 \text{ Hz}$, in the surrounding electrolyzer structures there is excitation of a broad spectrum of vibrations whose upper limit in order of value is estimated as

$$F_g = 2V/d,$$

where $V$ is movement velocity if the impact part of the hammer; $d$ is the depth of penetration of the impact part of the hammer into the material being broken. According to estimates of the upper limits of the vibration range $F_g$, caused by impact of a hammer, is 150 – 300 Hz.

When a hammer falls into a side, bottom of a bath or agglomerates having high strength, the range of frequencies excited may be higher by one to two orders of magnitude. However, since high-frequency vibrations are damped rapidly during propagation, the main action on the neighboring electrolyzers is low-frequency vibrations in the main frequency range of 150 – 300 Hz. This assumption is confirmed by experiments which show that the main frequency range

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during dismantling of an electrolyzer cathode unit, recorded in neighboring electrolyzers is within the limits 200 – 400 Hz.

The dynamics of vibrations that arise during operation of a dismantling machine with a pneumatic hammer PM 1700M4, are shown in Fig. 1. The pneumatic hammer impact frequency is in the range 4 – 4.5 impact per second. Here the maximum vibration acceleration in the cathode casing of a neighboring electrolyzer ~0.04 m/s²; recorded vibration amplitude ~0.2 mm.

![Fig. 1. Dynamics of impact acceleration on a neighboring unit during dismantling of an electrolyzer with operation of a pneumatic hammer PN 1700M4: hammer impact frequency 4.3 impacts per second; maximum vibration acceleration in the cathode casing of a neighboring electrolyzer ~0.04 m/s²); recorded vibration amplitude ~0.2 mm.](image)

Compared with the background, the vibration field of dismantling machine operation is accompanied by an increase in peak vibration loads in neighboring electrolyzers by a factor of 300 – 1800. Taking account of the duration of operation in breaking a lining of an electrolyzer cathode unit up to 1.5 days, the additional vibration load on neighboring electrolyzers that are in a row with the cathode unit being dismantled (average with respect to time) corresponds to 3.5 – 5 years. For the immediate neighbor electrolyzer in a parallel row this figure exceeds 1 – 1.5 years. As a result of additional vibration loads on an individual electrolyzer in time its standard operation is ~5 years, and as a result of carrying out major overhaul of neighboring electrolyzers, may exceed the background load in the same period by a factor of 1.5 – 2.0. Combined with high peak impact loads this means that dismantling the lining of an electrolyzer cathode unit by means of impact mechanisms directly in situ of its operation is one of the factors limiting the duration of electrolyzer standard operation.

In NTTs Innovation Technology SFU together with OOO Rusinzhiniring RUSAL Krasnoyarsk, technology has been developed for impact-free dismantling technology directly in the electrolyzer building currently only concerns old production, where there was no consideration of removing electrolyzers for major overhaul to special workshops, development of impact-free dismantling technology may be of interest not only in this particular case. Creation of impact-free dismantling technology in situ for electrolyzer operation within electrolyzer buildings in future may significantly reduce the time and material expended for their major overhaul due to excluding additional operations of controlling the work, avoidance of using special equipment and operation of special accommodation.

**IMPACT-FREE DISMANTLING TECHNOLOGY OF AN ELECTROLYZER CATHODE UNIT LINING BASED ON A HYDRAULIC PRESS EQUIPMENT AND DIAMOND CUTTING TOOLS**

In NTTs Innovation Technology SFU together with OOO Rusinzhiniring RUSAL Krasnoyarsk, technology has been developed for impact-free dismantling of a cathode unit lining...