

## ANALYSIS OF METHODS FOR ASSESSING THE QUALITY OF CLEANING REPAIR OBJECTS

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**Problem statement.** During machine repair, cleaning restored objects of operational and technological contaminants is crucial. Surface cleaning involves the removal of liquid and solid contaminants to a specific cleanliness level. Based on the physical and mechanical properties of machine contaminants and their components, contaminants can be conventionally divided into three groups by the complexity of their removal [1]:

I – road-soil contaminants, fuel-lubricant residues, metal shavings, abrasives, etc;

II – aged grease, oils, residues of cleaning agents, pastes, and mastics;

III – asphalt-tar deposits, carbon deposits, scale, corrosion products, and old paint coatings.

Specific technologies are developed to remove each group of contaminants. Cleaning operations result in achieving a certain surface cleanliness level, making research into effective methods for objectively evaluating cleaning quality relevant [2].

**Main research materials.** A clean surface is defined as a condition where only an acceptable amount of contamination remains for a given production or process. In repair production, three cleaning levels are distinguished: macro-cleaning, micro-cleaning and activation cleaning.

*Macro-cleaning* – removes the largest contaminants that hinder disassembly, defect analysis, and mechanical processing. Contaminant residues should not exceed 0,25–1,25 mg/cm<sup>2</sup>.

During *micro-cleaning*, traces of contaminants remaining after macro-cleaning and light production-origin contaminants (dust, emulsion residues, etc.) are removed. Achieving the level of micro-cleaning is crucial when preparing surfaces for applying paint and varnish coatings and during final assembly operations of units and components, as the cleanliness of surfaces in these cases directly affects the reliability and lifespan of the products. To ensure normal adhesion of paint and varnish coatings, partial contamination with lubricants of no more than 0,005 mg/cm<sup>2</sup> is permissible.

For assembly operations, the amount of oil contamination on the surface should generally not exceed 0,1–0,15 mg/cm<sup>2</sup>, as higher oil contamination significantly increases the accumulation of dust particles from production areas.

Even after thorough micro-cleaning, the surface remains contaminated with residues of surface-active substances, protective films, and inclusions of foreign substances. Cleaning the surface from such contaminants to prepare it for the application of electrolytic coatings should be classified as *activation cleaning*. For electrolytic coatings, this type of cleaning is an intermediate operation involving the etching of a metal layer 2–15  $\mu\text{m}$  thick. The remaining contaminants on the surface after cleaning are evaluated using various methods: weight, visual, and luminescent.

*Weight method* – contamination residues are determined by weighing the object before and after cleaning.

*Visual method* – surface contamination is compared with a reference scale. A ten-point scale correlates with specific contamination levels:

1 – practically no cleaning (residual contamination  $C \geq 5,0 \text{ mg/cm}^2$ ).

2 – slight smear of contamination, most of group I contaminants are removed ( $C = 1,6 \text{ mg/cm}^2$ ).

3 – breaks in contamination continuity, group I and most of group II contaminants are removed ( $C = 1,25 \text{ mg/cm}^2$ ).

4 – group II and some group III contaminants are removed ( $C = 1,0 \text{ mg/cm}^2$ ).

5 – isolated clusters of asphalt-tar contamination and loosened carbon deposits remain ( $C = 0,75 \text{ mg/cm}^2$ ).

6 – thin asphalt-tar film residues in some spots; most carbon deposits and corrosion are removed ( $C = 0,55 \text{ mg/cm}^2$ ).

7 – isolated carbon deposits, scale, corrosion, and old paint residues remain ( $C = 0,5 \text{ mg/cm}^2$ ).

8 – almost complete cleaning. Minor scale and soot residues remain, not exceeding  $0,25 \text{ mg/cm}^2$ .

9 – complete cleaning. Possible residual thin oil films detectable by luminescent methods ( $C = 0,1 \text{ mg/cm}^2$ ).

10 – complete cleaning. Total residual contamination does not exceed  $0,01 \text{ mg/cm}^2$ .

*Luminescent method* – used to control residual contamination from petroleum products. It is based on the fluorescence properties of certain substances (oils, greases) under ultraviolet light.

**Conclusions.** Given that the primary cleaning goal is contamination removal, the quality of cleaning serves as the optimization criterion. An analysis of effective methods for evaluating the cleaning quality of repair object surfaces has been performed.

### **References**

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