# Cleaning Of Renewable Products

***The European project CleanER (Cleaning Engineering for Remanufacturing) under the aegis of the EraSME Network aims to explore and combine knowledge and technologies in the field of remanufacturing. For this purpose the reputable German companies BU Drive, Herrmanns, Mela, MD Rebuilt, Klubert + Schmidt and the Slovenian company FerroČrtalič have decided to bridge link with the German Fraunhofer Institute, University of Bayreuth and University of Ljubljana.***

In the context of sustainable development remanufacturing is becoming one of the key industries. Remanufacturing of products starts with the elimination of the product from use. The reason for the exclusion is whether the reclamation or the end of product's life cycle. Since the remanufactured product provides the same warranty as new the need to ensure high quality reconstruction is high.

Remanufacturing of products is environmentally friendly because it saves energy, maintains the raw material, reduces air pollution and preserves the land from the disposal of waste material. Only in the reconstruction of automotive engine it saves 50% of energy and 67% of the work which is needed to produce a new engine. In addition to the impact on the environment and the economic development, the remanufacturing contributes also on the social sustainable development, for example by creating new productive jobs.

Remanufacturing of a product usually takes place in several stages, as shown in Figure 1. In the first stage the dismantling of end-of-life products is carried out (for example the whole product (car, etc.) or subassembly (engine), components are disassembled, cleaned, inspected and sorted. The diagnostic phase determines whether the components are suitable for further use, while some parts become scrap. Other components and parts that do not meet standards are remanufactured. In a further stage the assembly of remanufactured products, consisting of used, refurbished and/or new components is carried out. Such a product can be used as the original product or as a product with a new identity.

In spite of the rise and demand for this kind of segment in the remanufacturing industry there is not enough of the necessary knowledge neither in industry nor in the institutions of knowledge. In particular the problem is in cleaning technologies, which are on a very low level and have a large potential for improvements and innovations. This is why the involved companies pursued the CleanER project, a project which proposes a systematic approach to problem solving treatment. The objectives are: (1) to develop new methods and indicators for determining contamination, (2) to validate the new waste treatment technologies, (3) to define the procedures for analyzing contamination and develop measuring equipment and (4) to develop solutions for efficient material flow in the cleaning process. Based on the results of relevant research and development, an online knowledge base and decision support tool that provides user-friendly and efficient access to knowledge and information on cleaning processes will be developed. This tool will be available to project partners during the duration of the project and will be presented to industrial users, especially to small and medium-sized enterprises which are increasingly entering the business field of remanufacturing.

For the CleanER project a consortium was created consisting of representatives from industry and research institutions. It consists of the Fraunhofer Institute, University of Ljubljana and Bayreuth and four German companies: BU Drive, Herrmanns, Klubert + Schmidt, MD Rebuilt, all of which work well on the field of product remanufacturing and represent a broad spectrum of industries. A part of this project is also a German manufacturing company Mela, which has long term experience in cleaning processes. Among the important partners is also the Slovenian company FerroČrtalič, which manages applications in the field of surface treatment technologies and is a producer of innovative equipment for cleaning with dry ice, soda and conventional blasting processes. In addition, a consortium is supported by the European Network EraSME, ReMaTec news magazine and APRA (Automotive Parts Remanufacturers Association) association.

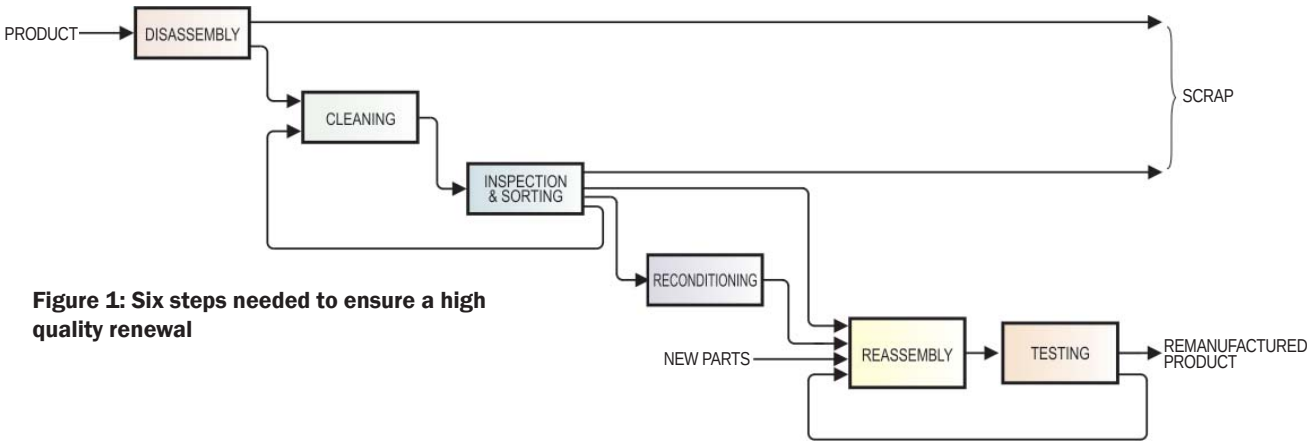


**Figure 1: Six steps needed to ensure a high quality renewal**


**Figure 2: Members of the project team on CleanER initial meeting in Bayreuth**

In January, the first meeting of the CleanER project was held and the members of the working groups set priorities, which will guarantee a successful realization of set goals. The project will be fully completed in 2013, but the most impatient users can expect first useful results in the form of verified solutions already by the end of this year.

Of the particular importance is that these companies have already established business relationships. Thus, the company FerroČrtalič has developed and delivered a robotic cell for cleaning diesel engine housings to BU Drive's subsidiary Scmitz + Krieger, which is located in Cologne, Germany. The cell operates as an autonomous unit in the new line of the remanufacturing of motor engines.

The technology used for cleaning is blasting with dry ice. The choice of technology for the given application is primarily based on process abilities to clean such contamination. The active mechanism in dry-ice blasting is based on a combination of the thermal and kinetic energy input, as well as sublimation energy. The thermal energy supplied during the cleaning process leads on one hand to a regional undercooling of the part when the pellets hit the surface. As a result, elasticity is lost and the dirt becomes embrittled and shrinks while forming cracks. Due to the different coefficients of thermal expansion of the end the substrate, the bond with the substrate dissolves when the adhesive energy is exceeded. The coating partially chips off. On the other hand, the kinetic energy of the stream of dry-ice pellets and air contributes to the removal of the coating. The sudden increase in volume resulting from the sublimation when the pellets hit the surface of the part supports the process, because pressure surges occur due to the sudden increase in volume by the factor of 800. Carbon dioxide gas flows under the adhesive coat. The material removal is hence based on a combined thermo-mechanical effect. The thermal effect is considered to contribute to 60% of the removal process, while the remaining 40% results from the kinetic energy.

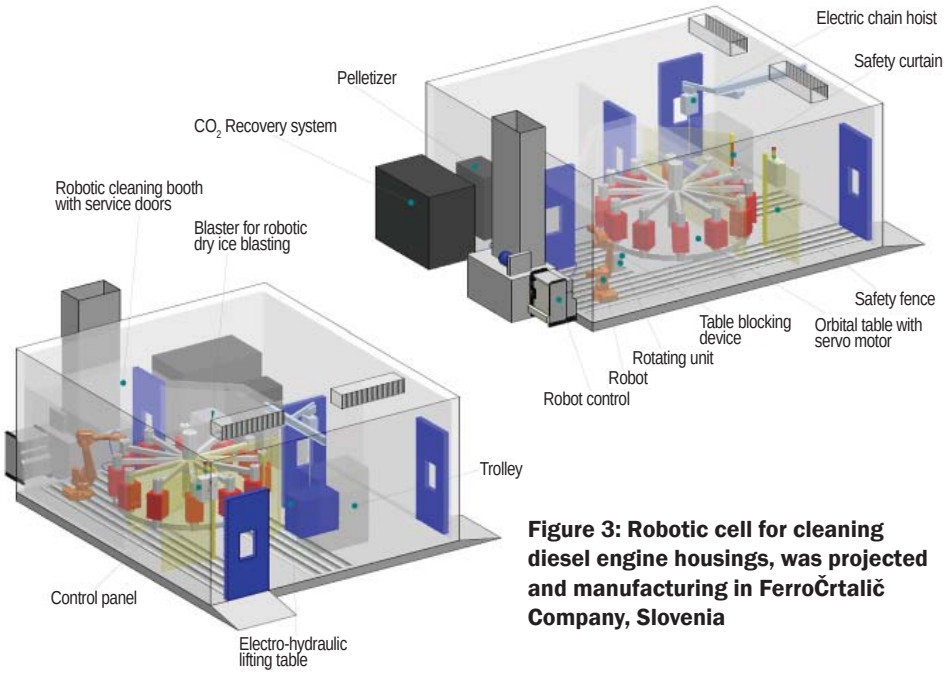


**Figure 3: Robotic cell for cleaning diesel engine housings, was projected and manufacturing in FerroČrtalič Company, Slovenia**

The core cell consists of a rotary table with clamping satellites and a robotic arm with a cleaning nozzle. Chamber, where the cleaning takes place has forced draft of fresh air in the environment as the process of cleaning with dry ice develops high concentrations of carbon dioxide. In the preparation of $CO_2$ pellets two main components are used: a unit for manufacturing of dry ice (pelletizer) and a recycling unit. In the production of pellets usually 50% of $CO_2$ evaporates in the atmosphere, but with the introduction of the recycling unit, up to 98% of losses can be saved. The device for cleaning and pellet manufacturing unit are located outside the treatment chamber, because this enables easier control and adjustment of process parameters during operation. As shown in Figure 3, the rotary table has 12 clamping satellites, which allows purification of up to three engines, which are consisted of four components.

Given the nature of the remanufacturing process, it is required that all engine components are cleaned within assembly. It is necessary to provide traceability of the components belonging to the same remanufactured product through the entire process of remanufacturing, which is essential to ensure the quality of the remanufactured engine. With the introduction of robotic cleaning in the BU Drive Company, cleaning of

**Figure 4: Final parameters settings and testing on parts of the customer**

engine components, removing plaque and cleaning the gaskets will be reduced to approximately one fourth of the time that was needed with manual cleaning. It is through the introduction of this treatment cell, the company will provide the basic requirement for increasing the capacity of remanufacturing of engine, which is of strategic importance for the further development and strengthening the position of the European and global industrial reconstruction engine provider.

In the context of global industrial development of remanufacturing the company FerroČrtalič presented their achievements this year at the largest fair ReMaTec2011 in the field of remanufacturing, held in Amsterdam (19.-21.06.2011), where Mr. Bojan Črtalič lectured on cleaning technologies through the various phases of development in the remanufacturing of products.

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**Figure 5: The CleanER project team meeting in Slovenia (from left: M. Haumann, S. Sweinstig, A. Sluga, B. Črtalič, N. Matjaž, P. Butala)**