

# 3Re Theorem

## Reuse, Reduce, Recycle

### Preface ▶▶▶

Readers will not find some super scientific treatise in this article. Nevertheless, it will certainly be of interest in today's difficult times when an energy, ecological or overall economic crisis threatens. There is nothing that readers do not already know from their own universal experience. Here, the author tried to recapitulate what's already known, unfortunately little-respected rules and implement them for the specific conditions of screw joints. Are there reasons and possibilities for using the 3Re theorem, which means Reusing, Reducing, Recycling in this industry as well? The answer is – YES, there are!

### Reuse ▶▶▶

How to clean the surface of rusted bolts? For example, can a spider (Fig. 1) help with that?



Fig. 1. Spider on a bolt

But now seriously. Surface corrosion is the most common and least harmful type of corrosion, because it uniformly attacks the entire surface of the part and is visible to the naked eye. As long as it has not penetrated into depth, it can be easily removed without losing the original mechanical properties of the carrier of this corrosion, i.e. metal bodies. Corrosion is actually a nasty parasite that robs the national income of 5 to 7%. It is primarily necessary to fight against it, but once it has arisen, it can be easily removed from the surface and thus considerable material values can be saved. The simplest method is the use of a steel brush. Suitable for series use of the vibration deburring machine known e.g. from the production of rolling bearing cages. The size and shape of the chips is at the

same time very important. Another option is blasting using a suitable abrasive medium or a chemical method of removing corrosion.



Fig. 2. Corrosion can also prevent loosening

Paradoxically, corrosion can also play a positive role, as it prevents screws from loosening (Fig. 2). The U.S. Navy even has a patented method of accelerated corrosion of screws so that they do not freely loosen during ocean liners. Despite everything, the most important thing is prevention!

### Reducing and Recycling ▶▶▶

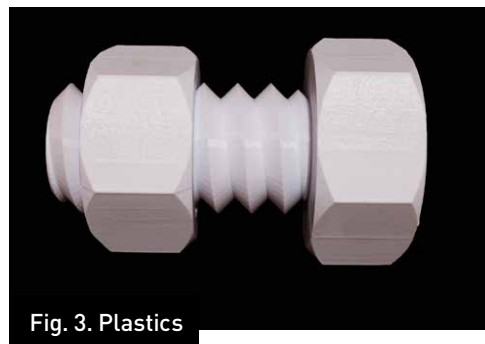


Fig. 3. Plastics

Products made of homogeneous material as steel, plastics (Fig. 3) and non-ferrous metals are OK from the point of view of recycling. However, it is worse with the combination of these diverse materials. The combination of steel-plastic (Fig. 4) or steel-rubber (Fig. 5) can serve as an example.



Fig. 4. Steel-plastic



The separation of non-metallic parts in this combined materials would be practically very expensive, and therefore both materials are disposed together in melting furnaces at a temperature of approx. 1,600°C.

The plastic ring represents rather insignificant part of the nut DIN 985 weight (4.55%) but considering the production of the thousands tonnes of the nuts, it is not so insignificant a mass of the pollutants which do not belong to the melting process and they contribute to air pollution, e.g. 1,000 pieces of DIN 985 M18 nuts = 44 kg and the part of the plastic component is ca. 2 kg. The above-mentioned fasteners are only one example of using the accessories of non-metallic origin for the purpose of locking or sealing together with metal parts. The relevant EU directives on waste dictate how to dispose plastic materials (Directive EU 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment). The aim of the waste regulation policy should be the minimisation of their negative impacts on the environment. The fasteners are not excluded from it and therefore they cannot be privileged.

Phosgene (other name: carbonyl dichloride), which evolves during the smelting process is a chemical compound with the chemical formula COCl<sub>2</sub>. At low temperatures, it is a colourless liquid with the smell of stale hay or rotting leaves. Phosgene gas is a highly toxic that was used as a chemical weapon during the First World War.

The obligation of the manufacturer or the supplier of fasteners made of heterogeneous materials should have instructions not only for use, but also for disposal at the end of its usef life! (Fig. 7)

Fig. 5. Steel-rubber



It's simple, e.g. for the locking nuts in Fig. 6, in which the plastic retaining ring used is easily replaceable or replaced by an all-metal variant.

Of course, there are many other practical ideas, for example C-zero technology. This applies mainly to protective atmospheres for the heat treatment of screws and nuts. These atmospheres (hardening and cementation) contain high amounts of CO<sub>2</sub> and flow freely into the surrounding air. The solution options are quite real. It is primarily the replacement of carbon with nitrogen or other inert gases (Argon). After all, a provocative question still remains open. Is it technically possible to use the protective atmosphere twice? But this is no longer a problem for manufacturers of fasteners, but of furnace equipment such as SAFED, EBNER, AICHELIN, etc. The author is ready to establish contact with these and similar companies again.

Fig. 6. Nuts

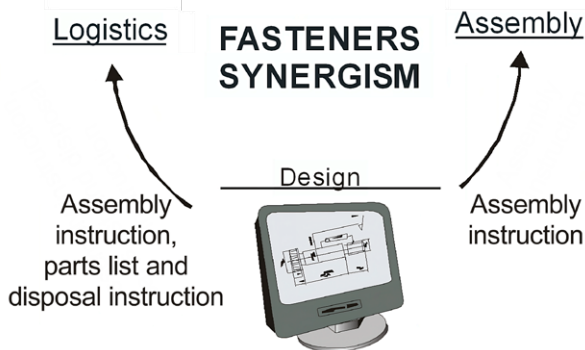


Fig. 7. Assembly and disassembly instructions

### Conclusion ►►►

The article presents several types of how it is possible to contribute to the improvement of the environment and reduce the energy consumption of production, even in the field of mechanical joining of parts. In the context of gigantic global industrial production and consumption, this may seem insignificant, but one must keep in mind that even the connecting elements, which mostly condition the production of higher structural units, have a not insignificant impact. After all, the well-known rule applies that: The sum of small events causes namely a big event, and so is this case. ■

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