

100 Companies for Resource Efficiency

Examples of excellence in Baden-Württemberg from all parts of the economy.

**For Example:
Franke GmbH**

Optimisation of material efficiency in the production process of a Wire Race Bearing

Franke GmbH, Aalen

Engineering/process technology:

Machining

Measure:

Design optimisation of a wire race bearing

Initial situation and objectives

One of Franke GmbH's main products is a highly dynamic wire race bearing for a medical technology application. Wire race bearings are based on a simple but ingenious principle. Individual wire raceways are fitted with a raceway that is precisely matched to the diameter of the rolling elements. This means that the rolling process not directly between the rolling element and the between the rolling element and the surrounding construction on the four open raceways. This design principle enables the free design of the enclosing construction in terms of geometry and choice of material.

The strong profiling of the individual components results in a material loss of more than 40 %. This associated with high costs for machining. Based on these facts Franke set itself the goal of optimising the production of the wire race bearing and increase material efficiency. With the help of a life cycle assessment and an economic analysis, the main environmental impacts and savings potential of the wire race bearing for small and medium batch sizes within the process chain were to be identified and suitable optimisation recommendations made. As part of the analysis, the specific environmental impacts of the components, such as the global warming potential, the eutrophication potential and acidification potential were to be analysed and, in addition, material flow cost accounting (MFCA) was to be carried out.

The challenge

Despite the goal of minimising the use of energy and raw materials, the existing customer specifications had to be adhered to when optimising the wire rod storage system. The successor model also had to have the same functionality and load-bearing capacity, while at the same time the economic efficiency of production had to be guaranteed. This meant that all optimisation recommendations and their effects had to be compared with the customer's specifications in terms of their feasibility.

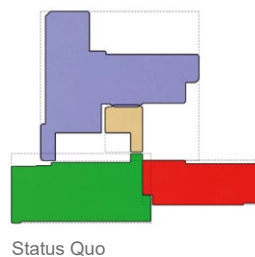
Idea

Based on the identified material losses, optimisations were to be developed in order to increase material efficiency. The design of the individual components was to be changed so that only a small amount of material had to be removed by machining. In addition, it should be investigated whether the hot rolling processes used for the blanks could possibly be replaced by casting processes in order to save even more machining steps.

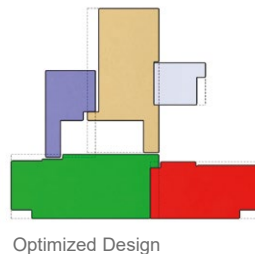
Realisation

In consultation with the customer, Franke realised the new design in several stages. The customer's framework conditions, such as the dimensions of the adjacent construction, interfaces and performance requirements, had to be taken into account when determining the new design. The technical departments of the customer and Franke worked closely together on this. The possible design measures were simulated, analysed and evaluated with the help of the 3D software Solidworks.





As rolled blanks are used to manufacture the bearing components, the cross-section of the individual parts was designed to be as rectangular as possible in order to minimise the machining process. For example, the ring AB (blue) was divided into two parts to further reduce the machining volume and save machine time.



Savings

In the original wire race bearing, an average material loss of around 40 % was incurred in the production process of the four races, which corresponds to just under 170 kg. In the production of the individual races, the material loss was more than 70 % in some cases. Hot-rolled standard steel (C45N) is used to manufacture the races. The reason for the enormous loss of material was the strong profiling of the individual components.

Material loss in the wire race bearing

Part	CO ₂ -Eq [kg]	Weight blank [kg]	Weight finished [kg]	Material loss [kg]	Material loss [%]
Ring - AB (blau)	701,39	229,3	110,3	119,0	51,9
Ring - AS (braun)	87,99	34,0	10,0	24,0	70,6
Ring - IB (rot)	123,25	49,3	41,0	8,3	16,8
Ring - IS (grün)	286,13	84,4	67,7	16,7	19,8
Σ		397,0	229,0	168,0	40

Loss of material in the successor model

Part	Weight blank [kg]	Weight finished [kg]	Material loss [kg]	Material loss [%]
Ring-AB (blau)	37,6	25,1	12,5	33,2
Ring-AS (braun)	93,9	67,2	26,7	28,4
Ring-A (hellblau)	19,5	16,9	2,6	13,3
Ring-IB (rot)	49,6	45,1	4,5	9,1
Ring-IS (grün)	84,6	68,8	15,8	18,7
Σ	285,2	223,1	62,1	21,8

which results from extensive machining. This machining not only accounts for a large proportion of the costs, but also contributes significantly to the environmental impact of the entire bearing. A significant factor here is the high power consumption due to the long machining time. By optimising the bearing, the total weight of the blanks is reduced by approx.

30 %. In addition, the loss of material in the successor model is now only around 22 %, which corresponds to approx. 62 kg.

Learning objective

Considerable material savings can be achieved by taking a forward-looking approach to new designs. The greatest potential can be realised if the customer involves the company in new developments from the outset, as this allows it to influence the design of adjacent components to some extent.

The project also shows that it is possible to harmonise ecological aspects and customer interests. In addition, costs can be saved through material savings, reduced machine times and savings on auxiliary materials such as cooling lubricants.

The company

Franke GmbH is the inventor of the wire race bearing and a global technology leader in the development and manufacture of lightweight motion systems.

In his search for a space-saving bearing for an optical device, engineer Erich Franke developed the wire race bearing in 1936.

The company's core competence is the development of innovative solutions together with customers. The versatility in terms of design and construction of wire race bearings always leads to optimum solutions for the respective application. Today, the product programme includes both rotary and linear components with and without drives.

Wire race bearings and linear systems from Franke are available worldwide. Representatives and partners in numerous countries advise customers and support them with products and services. Co-operations with strong partners in North America and Asia enable local production and contribute to supplying customers quickly and cost-effectively.



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The "100 Companies for Resource Efficiency" project was initiated by the Alliance for More Resource Efficiency between the leading trade associations in the state of Baden-Württemberg and the state government, the Baden-Württemberg State Association of the Chemical Industry (VCI), the Baden-Württemberg Association of Machinery and Plant Manufacturers (VDMA) and the Baden-Württemberg branch of the German Electrical and Electronic Manufacturers' Association (ZVEI).

The project is being carried out jointly by the Institute for Industrial Ecology (INEC) at Pforzheim University and the State Agency for Environmental Technology BW. The examples presented were carefully scrutinised and selected by a jury made up of members of the participating alliance partners.

The initiative demonstrates how resource efficiency can be implemented in practice and the associated benefits. It supports existing resource efficiency activities in the country with concrete, presentable results and brings them to the operational level of action. This motivates other companies to join in..

The 100 examples of excellence have an impact beyond Baden-Württemberg and emphasise the performance of the local economy. The aim is to emphasise and present the examples of excellence in a representative, publicly effective and exemplary manner.

Further information about the project:

www.100betriebe.pure-bw.de

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Baden-Württemberg

MINISTERIUM FÜR UMWELT, KLIMA UND ENERGIEWIRTSCHAFT