COPRA® Products for Flexible Pipes

Optimizing the Construction of Flexible Pipes for Deep-Sea Oil and Gas Exploitation
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Exploiting deep-sea oil and gas resources is a major challenge for exploration and conveyance. Ideal for the purpose are flexible, multilayer pipes that are able to withstand the enormous pressure at depths of more than 1000 meters, that are resistant to corrosion and also reusable.

To satisfy such demands combined with reliable functionality plus long lifetime, the conveying pipes are composed of a number of layers of different materials. Plastic layers guard against corrosion while various profile layers of sheet metal and wire absorb all the mechanical strain and stress caused by forces of tension, pressure and torsion. Low-cost mass production of these pipes is ruled out because of the different deep-sea conditions from case to case. Development expenditure consequently has a significant impact on overall cost.

Particular importance attaches in construction to the design of specially profiled reinforcement of different metal materials. For the complex design and simulation processes a professional basis is presented by COPRA® RF Software for Rollforming developed by data M Sheet Metal Solutions GmbH.

They optimize construction of the wire and sheet metal profiles, of the necessary roll forming tools, plus the winding process of metal profiles to form a stable pipe carcass. With its broad-based functionality the software very much reduces the time consumed by the design process, and high-performance simulation eliminates to a large degree the risk of design errors.

Specialized Software Simplifies the Design Process for Flexible Carcass of Wound Profiles

The inner layer of the pipe consists of metal reinforcing profiles that are wound around the longitudinal axis of the pipe and form-fitted with one another by their profile. The resulting carcass gives the pipes high resistance to mechanical stress while ensuring the required lengthwise flexibility.

Producing the carcass means a dual stress for the material because the sheet metal is first roll formed and then wound. A frequent problem in the winding process is the appearance of waviness on the profile edges.

If the profile at the outset of the winding process is not within certain tolerances, the stability and flexibility of the carcass can no longer be assured.

The consequences of the carcass breaking could be dramatic to say the least.

Continuous Process Chain Allows Timely Fault Detection

For complex design processes of this kind data M offers tried and tested, thoroughly engineered solutions: COPRA® RF for design of the profile and tooling, and COPRA® FEA RF to simulate the roll forming operation and the winding process.

COPRA® FEA RF simulation imports the previously generated profile and tool data and calculates deformations appearing in the profile. Because simulation of the carcass winding process can include all information found about material deformation in the first step – roll forming the sheet metal – a positive simulation result will mean that problems in subsequent practical implementation are most probably eliminated. A FEA simulation allows different kinds of investigation direct onscreen, in other words without prototyping and machine set ups. So the designer has a simple means of finding out more about the influence of different materials, or of determining the minimum radius for a planned winding process. In each simulation they gather new, specific knowledge that is a valuable support in future projects.
COPRA® RF Wire Rolling Supports Solid Metal Roll Forming

Another challenge in the construction of flexible conveying pipes is presented by the pressure armor. This is also produced by means of a winding process from a Z-shaped profile. The starting material for this profile is solid round steel, which first has to be roll formed to create the Z-shape.

Processing material up to 32 mm in diameter, roll forming it into a Z-profile, calls for high-performance tools or machines – and an experienced designer. COPRA® RF Wire Rolling software is a highly efficient means of support, for instance by automatically configuring individual roll forming stations based on the starting and end cross-section of the desired profile.

What also optimizes the process is the interactive configuration of the roll forming stations based on empirical values: The designer draws the planned roll forming stations, and then the contours for all necessary roll forming tools can be derived automatically or generated interactively.

Here too: Successful Process Simulation Means Sure Results

An essential element of roll forming solutions from data M is simple and speedy verification of the generated tool rolls by COPRA® FEA RF Wire Rolling. The software is powerful enough to analyze the entire process in 20 to 30 minutes, so the results of any modifications are available within a very short time.

Continuous Process Chain Allows Timely Fault Detection

COPRA® RF Software: Flower Design & Roll Tool Design

COPRA® FEa RF Analysis Software

COPRA® FEa RF: Investigation of the Result
In this way data M has often been able to offer users speedy and reliable support in a large variety of projects. Many users had been running try-outs for more than a year and still not achieved satisfactory results. Only after a successful simulation of the processes with COPRA® FEA RF Wire Rolling could material behavior be explained.

A major advantage is the fact that the powerful simulation enables you to look at each roll forming station individually. So data M engineers could immediately recognize the root of the problem: the enormous forces needed to roll form solid round steel were too unevenly spread between the individual stations. By matching two stations it was then possible to optimize the distribution of forces and achieve the desired result. The optimized result meant advantages for the end-product and wire cross-section as well as the manufacturing process. Because, given the substantially better shaping, no more cracks appeared in the material during roll forming, and winding the carcass was also quite straightforward. Plus, wear of the tools on the roll forming plant was reduced, energy consumption was lower, and machines were set up faster.

Conclusion:
Such examples demonstrate how COPRA RF solutions from data M can significantly increase efficiency in the construction of flexible pipes to convey oil and gas. The powerful simulation tools in particular allow early pinpointing of problem areas. They also enable you to better understand how material reacts in roll forming processes, and consequently expand corporate expertise.

COPRA RF software is a highly efficient alternative to the manual design of different profiles and the tools needed for the purpose. The software factors both the individual properties of the material to be roll formed and its maximum possible degree of forming. Problems resulting from impermissibly large deformation such as local strain hardening - these make a material brittle and cracked - are thus eliminated. Furthermore, COPRA RF software solutions are able to consider specific effects of the starting material, like elasticity or the property of cold worked metals to shift in a lengthwise direction rather than press into border areas. Such effects can considerably influence the dimensional accuracy of the profile that is to be produced and consequently must be mapped very precisely.

Further important and efficient support is derived from COPRA FEA RF simulation: It allows verification of tool geometries generated for profile production by simulating the roll forming process. COPRA FEA RF will also inspect the winding process of metal profiles. A successful analysis means that a tool is validated.