Calculation of specialised tooling based on tube geometry

MODERN tube bending machines offer a wide variety of options to bend tubes at angles and radii that just a few years ago would have been considered impossible. Options like multiple bending-levels or movable bending heads allow the manufacture of complex pipe geometries for a variety of uses.

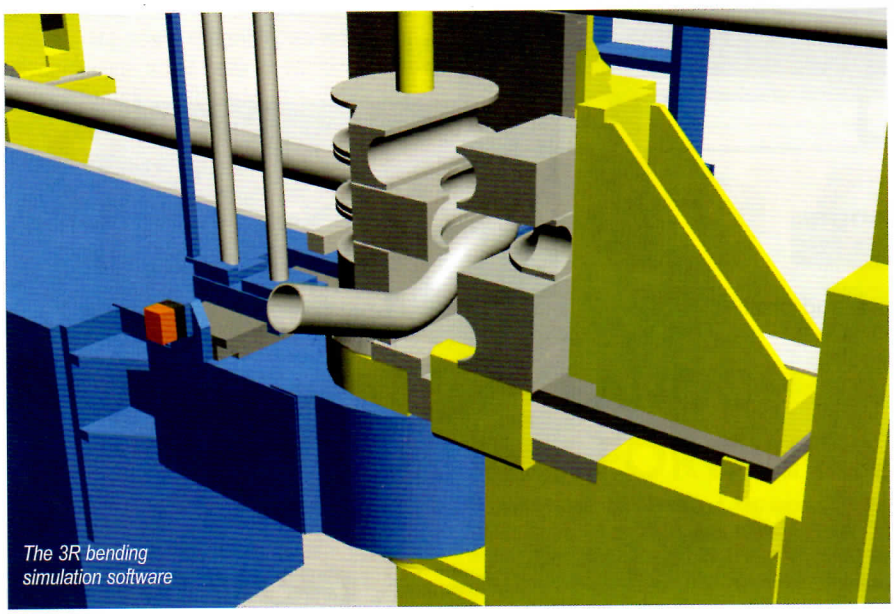
One problem that persists even with modern bending machines, however, is the difficulty of bends that are too close to each other. Since the clamp jaw that secures the tube has a certain length, this amount of straight tube is required between two bends for proper bending. Efficient bending simulation software, like RoniKolli7 by 3R software solutions will test every tube design, to make sure that this minimum length is provided, so the machine operator does not receive an order that is impossible to fabricate.

But for some projects it is indispensable to have two bends that are closer than the normal minimum distance required by the tooling. Especially for tubes that have to conform to confined spaces it is important that particular angles and radii are fabricated. For this situation special tools are required, that have to be manufactured specifically for this particular bend in this particular tube. These tools accommodate the shortened distance between the two bends by clamping part of the previous bend.

In order for a tool to clamp a bend instead of a straight pipe, the exact bending angle of the previous bend, adjusted for overbending and springback has to be known. In addition the rotation angle between the two bends has to be known, so the tube can be clamped after it has been rotated into the correct position by the collet. And finally it is necessary to calculate how much of the straight tube has to be clamped, to make sure that the groove for the first bend is positioned correctly. When these three values, commonly referred to as Traction, Rotation and Bending have been calculated correctly, the tooling manufactured to these specifications is capable of clamping this particular bend. But to successfully manufacture the second bend it is also often necessary to remove part of the tool elements in other bending levels, to allow for proper alignment and movement of the tube.

Until now the difficulty in creating special tools was that the calculations take a long time, and once the tool is designed the tube still has to be tested for collisions. By using simulation software it is at least possible to test the bending process without the need of a physical tool. But if the simulation result indicates that the tube is unbendable, and the bending order has to be reversed, then a new special tool has to be designed and tested. All of this takes time and effort, and reduces productivity, even if no actual physical tool is created, but merely virtual models for testing. Tool designers often spend days at a time designing a tool for a single bend, and then have to start over, if they realise that the tube is not bendable with this tool.

A new optional feature for RoniKolli7 by 3R software solutions makes this process faster and more convenient. Using this new function the bending process is simulated as usual. But the clamp die and its counterpart at the bending die are initially presented as solid blocks, without any groove for the tube. When the tube is now clamped by these blocks, the module automatically determines which parts of the blocks are displaced by the tube and have to be removed from the tooling. This way RoniKolli7 not only calculates the required specifications for the special tooling, but it immediately tests the tube for collisions. Springback and overbending are automatically taken into consideration, so the special tool that is created is the special tool that is required.



The 3R bending simulation software

If a collision is reported at any time in the bending process, the software will automatically attempt to find a solution, to the extent that the machine's capabilities allow. If this requires recalculating the special tool, the new specifications are saved. Once the tube is found to be bendable the CNC data required to fabricate it can be printed out on worksheets or exported in a variety of formats, so the data can be used directly at the bending machine. Data for the special tool is also provided, so the tool can be manufactured according to specifications. All of this is done within minutes, saving many hours, if not days of design time for every single bend.

But beyond the mere calculation of the tool specifications themselves, the feature offers even more to the tool designer. It not only indicates which parts of the tool dies on this bending level have to be removed, but also if parts of the tool levels above and below have to be ground off to avoid collisions. It calculates what percentage of the clamp die and bending die clamp have been removed, and whether the remainder is sufficient to securely chuck the tube. And if a tube requires multiple levels of special tooling, the software also determines which bending level would be best suitable for which part of the bending process.

By using this function a tool designer can perform calculations that previously took days within a few minutes. And since RoniKolli7 is used by many tube shops around the world, it is also interesting for construction departments without their own tube shop. They can design their tubes, test them for collision, and then give the data and the specifications for the tooling to the customer or contractor that bends the tubes.

The feature is now available as option for customers purchasing RoniKolli7. Existing versions of the software can be retrofitted with the feature upon request.

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