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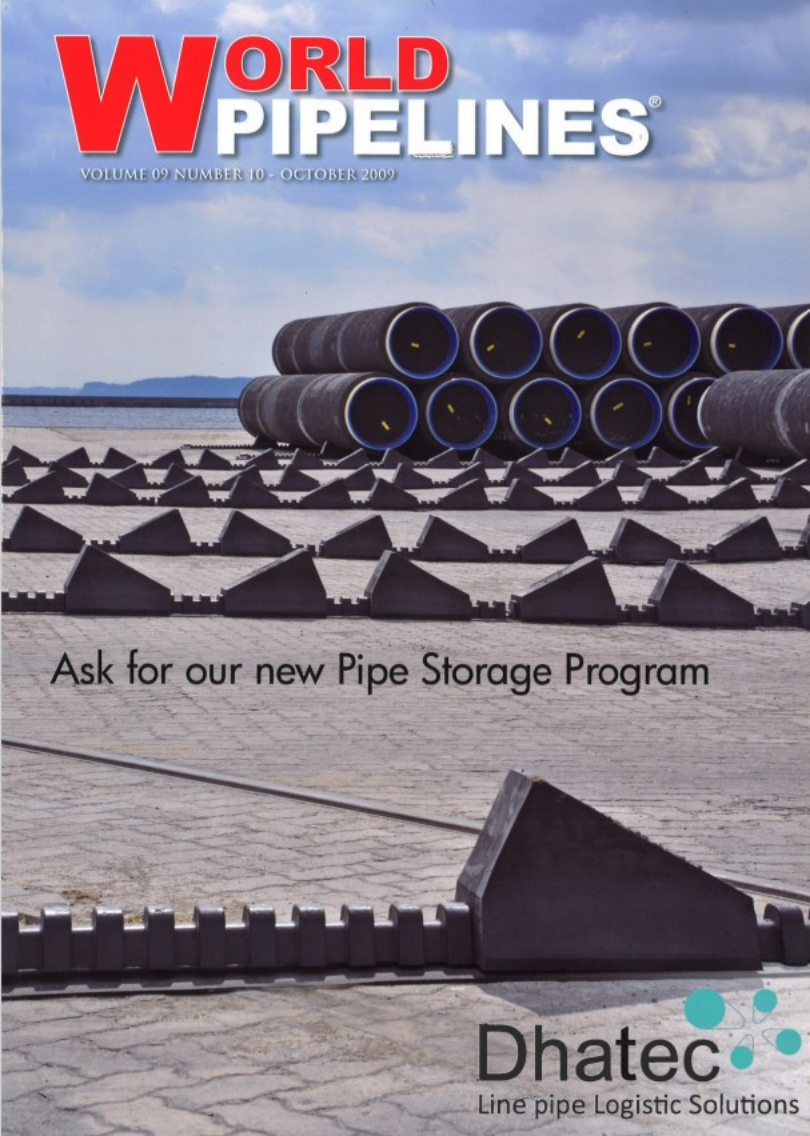

Figure 1. Flexible pipe storage on the quay side.

Ing. Idsart van Assema, Dhatec, The Netherlands, discusses the design of a safe support system for pipe stacks.

SAFETY IN STORAGE

Coated and uncoated pipes are stored a number of times before they are welded together and lowered into the trench. As a supplier to most parties in the pipeline supply chain, Dhatec has seen lots of different ways of storing pipes.

Stacks

Usually pipes are stacked on top of each other. The stack is supported by wood wedges, sand berms or steel constructions. During the period of storage, pipes can be subject to high pressure and weather influences. Supports that are used in

Figure 2. Heavyweight concrete coated pipes being stored on a new storage system.

the field are in most cases not designed to reduce these threats and can sometimes even worsen the situation (e.g. nails, stones, corroded steel). Obviously, this brings risks to the quality of the pipe and its vulnerable coating. Besides this, badly designed supports bring risks to employees as well.

Prevailing forces

Calculations that were made when designing a new pipe storage system showed that enormous forces are exerted on the supports of a pipe in storage. The challenge for Dhatec was to make sure that the new system could handle these forces, and to incorporate a safety margin. Looking back at the stacks that were investigated in the field, some of which were made of weathered wood, rusted steel and eroded sand berms, it is surprising that certain stacks did not collapse. In some cases it is only the friction between the pipes that keeps the stack from collapsing. But what if rain, snow or frost influences the friction? Walking in between the stacks not only feels unsafe, it is dangerous. This is why Dhatec initiated the development of a new storage system for line pipes.

Behaviour of pipes in the stack

The base for the new design is safety. All forces in the pipe stacks were analysed and a scale model was built to simulate the behaviour of pipes. Although it is only a scale model, it gives insight in full scale behaviour of pipes in a stack.

It proved to be important that the distances between the pipes in the bottom layer are equal. Two pipe support methods were tested: one only blocked pipes at the end, the other blocked every pipe from rolling.

Blocking at the end of the stack only

The first stack was built between end stops. This means that pipes are blocked from rolling only at the end of the stack. After loading the pipes it showed that the distance between the pipes was not equally divided. The space was concentrated on one or two locations and made the stack unstable. Eventually, pipes on the sides are pushed out of the stack and the stack resettles.

Would it be better not to leave any space between the pipes? The answer is no: when building a stack it is important that some distance is left between the pipes because pipes will deform under the load of the stack and become oval. If no distance is left between the

pipes it will cause extreme forces on the 3 and 9 o' clock positions on the pipes because of ovality. The trouble with using only end stops is that you cannot control the distance between the pipes.

Blocking every pipe

To make sure that the distance between the pipes is equally divided, the situation was then modelled where every pipe is blocked from rolling. In this way the distance between the pipes is controlled and the stack is more stable.

With this setup, the way of storage that is seen most is simulated: wooden bars with wooden wedges. In the field, wedges are nailed on the wooden bar to block the pipe from rolling after positioning of the pipe.

The new design goes further: depending on the diameter of the pipe, block settings for building the stacks are prepared. PE compound blocks are easily positioned on the steel-reinforced PE compound gear rack and the pipe can be positioned on the blocks. Because the block configurations are prepared before the pipe stack is built, there is no need to have employees working between the pipes during handling of the pipes.

There is always a distance between the pipes in order not to damage the coating due to deformation of the pipe under the load. The pipes are supported by the two surfaces of the blocks. The material that is used for the blocks is low density polyethylene, which is tough but softer than the material used for coated pipes. Due to the elasticity in the blocks, the supporting surface will take over the curvature of the pipe. In this way the coating of the pipe is protected against damage. The material has proved itself as Dhatec's pipe transport system and was subject to all kinds of tests with coated pipes.

Another important advantage of the design is that by supporting the pipes on two surfaces, the ovality is reduced. Finite element analyses show almost four times less displacement and almost two times less stress compared to a situation where pipes are supported by a beam. The prototype proved itself in practice and the system is in production. After putting so much effort into the design of the system, Dhatec is confident that its product for supporting line pipes during storage will define a new standard. Finally it is possible to control the quality of the pipe and its coating during storage. And, importantly, it offers a safe working environment besides stored pipes. WP