Doubling capacity per dedicated loading spot at fluid handling jetties

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Introduction
Feed lines have limited capacity, so the loading and unloading sequence is a time consuming process. To cope with this limitation, often more than one loading arm is connected at the same time, in order to double or triple the capacity.

Existing jetties that are to be upgraded in terms of handling ships with larger capacities, or to handle different kinds of fluids in addition to the ones already handled, would normally need to be provided with additional marine loading arms.

Adding loading arms to an old jetty often requires the jetty to be re-arranged. Sometimes the re-arrangement includes an extension of the jetty in order to accommodate the extra marine loading arms required. Extending jetties is usually a time consuming and costly process. Adding more lines without the need for major adjustment of the jetty arrangement would be a simpler, cost-saving solution.

Recently, marine loading arms were introduced with two fully separated fluid lines, which can be operated independently from each other on a shared base plate. This type of loading arm has been launched with the aim of doubling capacity on the same base plate as a single-line marine loading arm.

Design of marine loading arms
The loading and unloading of tankers principally needs articulated equipment such as loading hoses or loading arms to follow a ship's movements in the horizontal plane, where there are requirements to deal with drift and sway, and in the vertical plane because of changing water and draft level. Loading arms offer the possibility of including safety accessories and remotely operated quick couplers to make life easier for operators.

Marine loading arms consist of a piping assembly with two moveable pipes. The flexibility is achieved by swiveling joints, which are the critical component of loading arms. When marine loading arms became common some 50 years ago, the swivel joints were much less reliable than today. As a result, a supporting structure taking over the loads of the piping was absolutely required. Nowadays, swivel joints’ strength has drastically improved, which eliminates the need for a support frame for almost every application. A self-supporting loading arm is requires less steel and fewer components, and is therefore significantly more efficient with regard to the old generation marine loading arms, where a separate frame supports the liquid-carrying line.

Because of the high weight of the steel piping, both moveable pipes must be counterweight balanced. A well thought-out design would optimize the design in such a way that only one rotating counterweight is needed for both moving pipes. Moreover, a rigid connection between the counterweight and outboard pipe instead of a cable and wheel system further increases the efficiency, as shown in Figure 1.

Design of symmetric marine loading arms
Conventional marine loading arms have permanent overturning moment on the jetty due to the fact that first moveable pipe (called the inboard) is mounted aside the fixed part, called stand post or riser. This is unavoidable since the swivel joints connect the moveable pipes via elbow pipes, and the bend radius of two elbows creates the offset between the riser and the inboard.

A symmetric design, however, equally divides the mechanical forces on the swivel joints and within the loading arm structures itself, significantly extending service life. In addition, the symmetry reduces the overturning moment (OTM) on the jetty to almost zero. This makes them especially suited for extraordinary applications like oversized dimensions and mounting on moveable carts and floating jetties (see Figure 2).

The symmetry is achieved by applying two inboards, each with the same offset towards the riser.

Possibilities of symmetric marine loading arms
A symmetric design clears the way towards a number of very interesting possibilities with regard to different executions, if not only the inboard is doubled, but the riser and outboard as well. It requires very careful design, but the additional riser, inboard and outboard can be configured as a completely separate second liquid line, fully part of the self-supporting construction of the symmetric marine loading arm.

The additional line provides the following applications:

1. Integration of large diameter and high pressure vapor return lines
In an increasing number of cases, local authorities require a vapor recovery system in order to minimize the escape of VOCs to the atmosphere.
Symmetric marine loading arms provide the possibility to not only accommodate a so-called piggyback-mounted vapor line, where the liquid line takes all the weight from the vapor arm, but also to fully integrate the vapor line in the structure, meaning that there are basically no limitations on the diameter of the vapor line. The only remaining limitation is the design pressure due to the connecting hose.

This is a significant improvement, since conventional marine loading arm would only accommodate a piggy-back mounted vapor line up to a certain maximum depending on the carrying structure, which will soon end up being huge (see Figure 3.)

2. Integration of a second fully rigid line for a different product

Basically the same configuration of the marine loading arm with integrated vapor line can be applied for a second, fully rigid liquid line. Instead of the connecting hose, a rigid connection can be made for both of the liquid carrying lines.

Two liquid lines in one structure significantly save costs when compared to two single-line marine loading arms. Moreover, the jetty does not need to be extended or even reinforced, since the overturning moment still remains zero because the symmetric design is maintained.

This configuration is suited to connect one liquid line at the same time (see Figure 4.)

3. Integration of a second fully rigid line to double capacity

The limitation of the previously described execution is that it results in both lines being part of the same construction. If the aim is to double the capacity by connecting two liquid lines at the same time, an entirely new concept must be developed. Symmetry needs to be maintained while simultaneous connection of two liquid arms would require full independent movement of each liquid line.
Both requirements have been met with the recently introduced so-called twin arm. This concept consists of two independently controlled product lines mounted on one base plate. The liquid lines are mirror shaped and the still existing symmetry still ensures a virtually zero overturning moment on the jetty. In fact they combine two full-option marine loading arms in only one assembly, sharing the same jetty floor space initially assigned for just one loading arm.

Simultaneous connection of two liquid lines from the same marine loading arm assembly can double the capacity and enables newly designed jetties to be considerably smaller, and existing jetties to be upgraded without major jetty adjustments. This is a very important cost-saving feature (see Figure 5.)

Conclusion

Applying multi-line marine loading arms and integrated vapor lines, including the ones with large diameters, can significantly increase loading efficiency. High-reliable symmetric MLAs have been available for self-supporting applications for some time. Recently, a multi-line marine loading arm has been launched with fully independent product lines for simultaneous connection of both liquid lines.

This feature doubles the capacity of the assigned jetty floor space for loading arms, and means a significant contribution to improving jetty efficiency.

ABOUT THE AUTHOR AND COMPANY

Robin Boot is Sales & Marketing Manager at Kanon Loading Equipment BV who he joined in 1999.

Kanon is a first-class supplier of marine loading arms and the only manufacturer of marine loading arms with innovative symmetric design.

ENQUIRIES

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