

## Summary

During the transshipment of bulk cargo material is spilled. Part of this ends in the surface water. Rijkswaterstaat demands to take measures to prevent this. Some time ago, Rijkswaterstaat and OVET B.V. disagreed about which measures are reasonable and which not.

The project group 'spillage prevention at grab transshipment' started an investigation to clarify things and improve the communication between Rijkswaterstaat and the bulk terminals. This project group consists of TUDelft, Rijkswaterstaat, Niema, Syntens, Erasmus universiteit and 12 bulk companies: EBS, EECV, EMO, EP Stevedores, IGMA, Maja stuwadoers, Marcor, OBA, OVET, RBT, Rietlanden en ZHD. Mart van Wijngaarden developed a model for Rijkswaterstaat and the bulk companies to be able to judge the spillage measures in an objective way [van Wijngaarden, 2007]. He introduced the 'cost effectiveness' being the costs of a measure divided by the effectiveness of the measure in euro/kg. In his recommendations he writes that the following questions have still to be answered:

- How much material is spilled on the water?
- How much harm causes this to the water?
- What are the possibilities to prevent/reduce spillage on the surface water and what are the costs and the effectiveness?

This report concentrates on the last question. It appeared that next to cost effectiveness the way in which a bulk company organizes his activities is an important factor in judging measures as well.

For the transshipment of bulk cargo, ships, floating cranes and barges are moored in such a way that the grab moves as less as possible over open water. However, sometimes it is difficult to prevent this. Sometimes one chooses to move over open water to prevent damage, because the vessels have different dimensions or because of lack of space to moor the vessels in a proper way. Especially when weighing towers are used this lack of space is an important factor. For the transshipment of bulk cargo with cranes on the shore it is more easy to prevent the grab from moving over open water.

To prevent spillage one can take primary measures or secondary measures. A primary measure is a measure that prevents spillage or reduces spillage. A secondary measure is a measure that prevents the spillage ending in the surface water.

### Primary measures

The most important primary measure is taken by the crane driver. He has to work responsibly. The culture of a company has a large influence on the way in which a crane driver works. There are a few measures to stimulate the crane driver to work without spillage. The best measures are an environmentally aware company, good training and good guidance of new crane drivers.

For the grab, the most effective measures are those to prevent spillage between the lips of the grab and those to prevent spillage over the edge of the grab. To prevent spillage between the lips good maintenance is important. That means checking the lips regularly and changing them if necessary. For dusty materials rubber sealings are effective. However, these sealings are very sensitive for wear. An other possibility is the use of overlapping lips. However, these are not suitable for coarse and dusty materials.

To prevent spillage over the edge of the grab, the closed grab is the most effective. However, for materials that are difficult to deform, it is not wise to use a closed grab. It could be better to use a conventional grab or a grab with a raised edge.

Spillage of material that lies on top of parts of the grab and spillage that falls out of the grab after emptying can mostly be neglected. However, some measures have a reasonable cost effectiveness because of their very low costs. For example the skewed little plates to prevent material from lying on the grab.

### **Secondary measures**

Secondary measures should only be used when primary measures are not possible or not sufficient. Their cost effectiveness is substantially lower because of their high costs and their relatively low effectiveness.

The most effective secondary measures are the cover measures. One of the cover measures is the spillage pontoon. However, it appears that the spillage pontoon is limited in its application because of the amount of situations in which it can not be used to cover the surface water. One could increase the cost effectiveness by using the spillage pontoon as fender pontoon as well.

Reducing the area of open water between ship and shore by decreasing the width of the fenders is very costly. The effectiveness is very low because the area is already very small. However, when planning new quays it is worth taking it into account.

In most cases the fenders of the pontoons can not be decreased in width without causing damage to the ship.

Feeding back of the spillage is only reasonable for shore based installations, like bridge cranes with discharge hoppers. The costs are very high and the effectiveness is very low because the spillage would fall down on the quay and not on the surface water.