Summary

Dust has a serious impact on the environment and the health of humans. Concerning dust, several studies of environmental agencies around the world have shown that airborne fine dust concentrations even at concentrations which are found in the open air can have an adverse impact on people's health. The reasons for dry bulk terminals to reduce their dust emissions are apparent.

The main question here is: "What are the most economically feasible dust suppression techniques available for import and export dry bulk terminals?"

Dust is made out of two groups: Fine dust with a maximum particle aerodynamic diameter of 10 µm, and coarse dust with a aerodynamic diameter of between 10 and 100 µm.

The European legislation states in the directive IPPC 2008/1/EU that in order to prevent dust emissions the Best Available Technologies (BAT) must be used. The official definition of BAT is:

'best available techniques' means the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.

In the Dutch regulations the difference is made between fugitive and canalized emissions sources. For canalized sources a maximum dust concentration in the exiting air flow is set at 5 mg/Nm^3. For fugitive sources the environmental law states that no visible clouds of dust may occur more than 2 meters of the source. No limits are set for the exhaust of fine dust for terminals at the moment.

To determine what dust suppression measures are usable per dry bulk commodity, the dry bulk is classified into 5 groups based upon whether they are wettable and/or drift sensitive. The dispersiveness classes are:

- S1: highly drift sensitive, not wettable
- S2: highly drift sensitive, wettable
- S3: moderately drift sensitive, not wettable
- S4: moderately drift sensitive, wettable
- S5: not or very slightly drift sensitive

Dust emissions occur when the bulk material is handled. The handling includes:

- the transport: the bulk material is in motion in or through equipment with a mostly constant velocity.
- transfer: the transition of the bulk material from one piece of equipment to another with a velocity that is mostly not constant.
- transshipment: the transition of bulk materials from transport equipment to storage equipment or vice versa.

Besides the dust emissions during handling, also during storage dust emissions occur. The definition of storage is:

- storage: planned lying of bulk materials with the material having no velocity.

The dust suppression approaches are determined for when the dry bulk material is in storage and for when its handled. These approaches can be divided into two groups:

- Primary approaches are the ways of reducing emissions during storage and handling and can be divided into:
  - organizational primary approaches; the behavior of the operators.
  - constructional primary approaches; constructions which prevent dust formation
  - technical primary approaches; techniques which prevent dust formation.
- Secondary approaches are abatement techniques to limit the distribution of dust.

Storage dust suppression measures

For bulk materials in the dispersiveness classes S1 and S3 enclosed storage is a necessity because they are not wettable. Enclosed storage would result in the highest level of dust emissions reduction.

However at the moment this is not economically feasible and so terminals nowadays usually store their products outside.

In general the most effective dust suppression for open storage at the moment is the combined use of wind protection and moistening the bulk material. The wind protection limits the dust emissions during stacking and reclaiming and reduces the wind speeds over the storage facilities. The moistening protects the bulk material when in storage. The downside of this method is that it can not be applied with wind speeds exceeding off 6 m/s. The wind protection reduces the wind speeds close to the storage facilities and so the moistening can be carries out even at the surrounding wind speeds above this limit.

Handling dust suppression measures

In general the most effective way of reducing dust emissions is to optimize the design of for instance a grab or conveyor belt. What handling technique to use is mostly not determined by the dust emissions but by other factors like the properties of the handled material and the terminal lay-out.

For internal transport on the terminal the preferred way is continuous. In terminals all the primary organizational measures for the lay-out should be implemented because this effectively reduces dust emissions at a minimum of costs.

The pipe and pouch conveyor all fully enclosed and protect the transported material from the environment. The return belts are closed as well, resulting in the enclosure of any caked-on material. The pouch conveyor is capable of making relative sharp bends, which allows for less transfer points. Because at transfer points the belts have to open, at that point almost all of the dust emissions occur. The pouch and pipe conveyor have low capacities in comparison with the conventional troughed conveyor which makes them unusable in some cases.

Whenever possible the design of the loading and unloading equipment should be done in such a way that the free fall height, descending speed and the material and spillage of material are minimized.

To avoid emissions in open conveyors, transfer chutes and loading and unloading equipment, the method of moistening the material or the dust is a good solution but not always applicable. For materials in the S1 and S3 dispersiveness classes the only solution in an open configuration conveyor is to enclose the conveyor, which leads to the necessity of using a suction system with dust filters. The use of suction systems should be avoided when possible because of its many downsides.

The most important factor in determining how to handle and store the bulk materials are the involved costs. A terminal will usually opt for the most cheap form of handling and storing the bulk materials still allowing complying to the rules. These forms have to be determined case by case. This may result in the above given preferred equipment not being used.

The objectives for the emissions of fine dust particles of the European Union and the legislation for terminals of the European Union do not correspond to each other. New legislation for the emission limits of terminals is under development. This means that in the nearby future more and stricter dust suppression measures will have to be implemented. Stricter environmental protection will cause closed storage to be more widely used . As for the handling the expectations are that more and more conveyor systems with a closed configuration will be used.