Silt Protector is a flexible membrane product that has been designed to physically prevent diffusion of pollution generated in dredging or reclamation works on the seas or rivers.

The pollution (fine particles) is said to badly affect the benthic organisms (marine life that live in the bottom) including making the breathing of fishes difficult and reducing underwater illuminance. The Silt Protector prevents diffusion of pollution safely because it uses a physical means without using chemicals that will be the cause of the secondary pollution.

The Silt Protector basically consists of the curtain section that is made of synthetic textile (mainly polyester), the float that hangs the curtain in the water, and the mooring section for fixing the unit at a specified location.
Models and Features

The Silt Protector consists of several types that are individually subdivided into some ranks so that the user is able to select units best suited to specific site conditions and work items. The Silt Protector can be used individually or separately, or by combining the units.

**Fixed Hanging Type Silt Protector**

This type is used the most frequently. It basically consists of floats on the surface and curtain and weight chain below the surface. One span of this product is 20m long. It is moored to the bottom through anchor ropes and anchors at every 19.5m point. The anchor ropes are steel wire type or synthetic fiber type, and anchors are concrete blocks, usually.

When this product is used under high wave conditions, the curtain with the vertical length of 10m or less is used and standing type is used together in many cases. When wave is low, the curtain of 20m long or more may be used.

The fixed hanging type Silt Protector is classified into four ranks, A, B, C and D so that a type best suited to a specific application can be identified.
### General site condition for hanging fixed type

<table>
<thead>
<tr>
<th>Rank</th>
<th>Suitable site conditions</th>
<th>Float dia (mm)</th>
<th>Float type</th>
<th>Curtain material</th>
<th>Chain weight (kg/m)</th>
</tr>
</thead>
</table>
| A    | Area outside of breakwater  
  - Wave height: 1.5m or less  
  - Velocity of current: 0.5m/sec or less | 600 | Unspaced | SPO- #800 or 500 | 10 |
| B    | Wide area inside of breakwater, or inside of inlet that is sheltered by the natural submarine topography  
  - Wave height: 1.0m or less  
  - Velocity of current: 0.2m/sec or less | 400 | Unspaced | SPO- #500 or 300 | 5 |
| C    | Area with medium extent inside of breakwater  
  - Wave height: 0.8m or less  
  - Velocity of current: 0.1m/sec or less | 300 | Unspaced | SPO- #500 or #300 | 5 |
| D    | Lakes, or well sheltered area as calm as lakes  
  - Wave height: 0.5m or less  
  - Velocity of current: 0.05m/sec or less | 300 | Spaced | SPO- #300 | 3 |

**Remarks**
- Standard unit length is 20m.
- Anchor is not included in the unit.

### EFFECT

Silt Protector generally provides the following effects on prevention of diffusion of pollution in the sea.

1. **Acceleration of settlement of silt by interference of particles**

   Installation of the Silt Protector suppresses diffusion of the pollution and make the soil particles interfere with each other to accelerate their settlement.

2. **Reduction of distance required to settle the silt**

   Installation of the Silt Protector as shown narrows the settlement range, resulting in minimizing the diffusion of pollution after the unit.
**Frame type Silt Protector**

This type has been designed to enclose local pollution caused by the grab dredging. It consists of floats (usually discharge pipes are used), curtain and ballast at the bottom. Mid-ballast may be added as necessary. Many of this type is made so that the length of the curtain can be changed according to the depth by using a winch and wire rope. The length of the curtain is made less than 15m for easier used on the grab dredger.

**Combined installation**

Frame type Silt Protector is, in many cases, installed together with hanging type to avoid turbid water when dredger moves, tucking up curtain. For deep sea like 20m water depth, combined installation of hanging type and standing type is sometimes used. In case, boat passing is necessary, sinkable hanging type is used for open part.
**Standing Type Silt Protector**

The standing type Silt Protector has been developed to prevent diffusion of pollution that may occur near the bottom in dredging or dumping of soil. This type consists of an anchor (normally steel H beam is used), curtain and float that pulls up the curtain with its buoyancy. The diameter of generally used float is 300mm (spaced type), and one span of this type is 20m long. In many cases, this type is used together with the hanging type product.

**Sinkable Hanging Type Silt Protector**

The sinkable hanging type Silt Protector is used when it is necessary to make an entrance/exit for the passage of vessels that enter into or exit from the reclamation area. The fundamental construction of the sinkable hanging type Silt Protector is similar to the fixed hanging type Silt Protector except that the float is inflatable. The float is hollow and is made of synthetic rubber.

When making this unit afloat on the water, the float is inflated by charging it with air, that can be completed in a very short time. The unit can be sunk immediately by deflating the float. The typical case of application of the Silt Protector is the reclamation of artificial island.
## Application

### Cross Section

<table>
<thead>
<tr>
<th>Pollution Removal Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 - 15</td>
</tr>
<tr>
<td>60 - 12</td>
</tr>
<tr>
<td>50 - 12</td>
</tr>
<tr>
<td>80 - 15</td>
</tr>
</tbody>
</table>

### Type of work

<table>
<thead>
<tr>
<th>Type of work</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredging</td>
<td><em>Cutter suction dredging</em>&lt;br&gt;<em>Grab dredging</em>&lt;br&gt;<em>Hopper suction dredging</em></td>
</tr>
<tr>
<td>Offshore dumping</td>
<td><em>from hopper barge</em>&lt;br&gt;<em>from hopper suction dredger</em></td>
</tr>
<tr>
<td>Reclamation</td>
<td><em>Substitution for dike</em>&lt;br&gt;<em>Spillage drainage</em></td>
</tr>
</tbody>
</table>

### Pollution Removal Rates

- **Upper layer, left side**
  - 41.0 - 14.3
  - $\times 100 = 65.1$
- **Upper layer, right side**
  - 36.4 - 14.1
  - $\times 100 = 61.3$
- **Mid layer left side**
  - 37.6 - 20.2
  - $\times 100 = 46.3$
- **Mid layer right side**
  - 35.1 - 18.1
  - $\times 100 = 48.4$

### Additional Information

- Pollution removal rates shown in the above table are data taken from actual sites.
- Turbulence caused by dumping from barges.
**Examination Flow**

It is recommended to follow the flow described here to make the planning of installation of Silt Protector.

**Design conditions**
- Wind velocity
- Current velocity
- Wave height
- Wave period
- Wave length
- Bottom soil
- Period of use
- Water depth
- Tidal range

**External force**
The design external force, $W$, applied to the Silt Protector is divided into the following three types of horizontal pressures:

- Pressure from flow $W_1$
- Pressure from wave $W_2$
- Pressure from wind $W_3$

**Estimate conditions**
- Area of work
- Work item
- Dredging rate
- Working hours
- Operation period
- Soil data
- Target value of SS
- Current velocity
- Water depth

**Typical diffusion of pollution**

Taiyo Kagya Corporation theoretically estimates the diffusion of pollution in case no Silt Protector is used, and effect of Silt Protector.
Installation works for Fixed Hanging Type Silt Protector

Preparation
* Preparation of working yard
* Making anchor blocks
* Bring materials to the site

Assembling on the land
* Inspection
* Series connection of spans
* Temporary tucking up of curtains

Installation works on the sea
* Loading on the barge
* Towing barge
* Placing anchor blocks
* Installing Silt Protector
### Specifications for the curtain material

<table>
<thead>
<tr>
<th>Material Code</th>
<th>Tensile Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPO-#800</td>
<td>800 kgf/3 cm</td>
</tr>
<tr>
<td>SPO-#500</td>
<td>500 kgf/3 cm</td>
</tr>
<tr>
<td>SPO-#300</td>
<td>300 kgf/3 cm</td>
</tr>
</tbody>
</table>

### Material for curtain and float components

The curtain and inner cover for the float are made of high strength polyester synthetic fiber that has been studied and developed to give excellent durability, cold-resistance, chemical resistance and light resistance.

The float cover (outermost cover) is made of high strength polyester tarpaulin with superior UV (ultra violet ray) resistance in addition to the features of the polyester synthetic fiber.

The float is made of solid cylindrical styrene foam with high weather resistance. Since the material will not absorb water, the buoyancy of the float is not reduced. The float adapts to the wave well thanks to the advantage of the material.