

# TRASHRACK CLEANERS TYPES - EXPERIENCES

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Abstract: There are innumerable types and designs of trashrack cleaners on the market, so the user has a wide variety from which to choose. In fact, today's trashrack cleaners are so high in quality that one's choice could be based on subjective factors such as personal preferences for certain drive systems, design varieties, etc. This presentation is restricted to the big travelling trashrack cleaners with a cleaning length of ten meters and up. We will compare the classical wire rope type trashrack cleaner, operated since the beginning of the use of hydropower for the generation of electricity, with the hydraulic jib type, which, in the size discussed here, has only been built for a few years. We will not discuss additional functions such as stoplog handling, etc.

## 1 Trashrack Cleaners: Types, Overview

### 1.1 Stationary trashrack cleaners

There are innumerable varieties of trashrack cleaners, especially of the stationary type. Stationary trashrack cleaners are mostly used where the rake can be built with the same width as the trashrack. This condition is satisfied generally in small hydropower plants. There are hardly any limits to creativity in designing this type of trashrack cleaner.

The following pictures will give you an idea of the variety of trashrack cleaners available.



Reutte Power Station  
Wire rope trashrack cleaner



Murau Power Station  
2 wire rope trashrack cleaners



Kohleben Power Station  
Wire rope trashrack cleaner: rake width ~9.0 m



Gössnitz Power Station  
Chain driven trashrack cleaner (chain guides in serviceposition)



Piuk Power Station  
Rack-and-pinion trashrack cleaner



Triebenbach Power Station  
2 hydraulic telescope trashrack cleaners



Arriach Power Station  
Hydraulic jib trashrack cleaner

## 1.2 Traveling trashrack cleaners

The number of available designs of traveling trashrack cleaners has been reduced. This presentation compares two types of trashrack cleaners: (a) the wire rope type cleaner, and (b) the hydraulic jib type cleaner.

### a) The classical wire rope type trashrack cleaner

This type has been used since electric energy has been generated in hydropower plants.

The machine consists of the following main components:

- Baseframe with travelling device

- Winch with rake

- Debris storage and/or debris disposal (container or flushing conduit, or other systems)

Many solutions have been especially created for debris disposal, depending mainly on the practicality of transportation. Debris disposal by flushing the debris downstream has not been allowed in new European plants (e.g., by a flushing conduit) because of environmental reasons. Accessories such as timber grabbers or orange peel buckets may be mounted on cranes to remove large pieces of debris such as trees and logs. Surface rakes are used to gather and drift floating debris.



Feistritz Power Station  
Traveling wire rope trashrack cleaner

b) The hydraulic jib trashrack cleaner

This type has been available in the size discussed here for only a few years.

The machine consists of the following main components:

- Baseframe with travelling device
- Pivoted machine house with booms and grab rake
- Debris storage and/or debris disposal

The collected debris usually is dropped temporarily into a concrete pit or a container to be disposed of later. The grab rake is also designed to pick up larger objects and to drift floating debris.



Leoben Power Station  
Hydraulic jib trashrack cleaner

## 2 Operating sequences

### 2.1 Classical wire rope type trashrack cleaner

#### Trashrack cleaning operation

The rake is lowered in open position. At the bottom of the rack, the rake is closed and lifted again. During the lifting, the debris is collected from the rack-bars.

The debris is then lifted over the sliding plate in front of the trashrack cleaner and dropped into the container or flushing conduit or other storage place.

During cleaning, the toothed cleaning plate of the rake fits between the rack bars.

The operating sequences are as follows:

- Trashrack cleaner in home position
- Rake in home position (standard: rake lifted, rake open)
- Rake is lowered to the bottom of the rack
- Rake is closed
- Rake is lifted and collects the debris from the rack
- Rake drops the debris into the container, ...
- Rake returns to home position
- Trashrack cleaner moves to the next cleaning position

Container: as soon as the container is full, it will be replaced or emptied.

Flushing conduit: debris is flushed to the downstream area.

The trashrack cleaner returns to the home position only when the container is being changed or emptied.

An average cycle can take less than five minutes.

The lifting velocity of the rake is limited only by the power of the winch. The lowering velocity depends on the weight and shape (flow resistance!) of the rake. A lowering speed of the rake causing slack ropes is possible but not useful.

Surface rake operation

The surface rake is lowered until its teeth are deep enough in the water to move the floating debris. The trashrack cleaner drives to the weir, pushing the debris with it. The floating debris is then drifted downstream over a slightly opened weir gate.



Trashrack cleaner Feistritz Power Station  
Surface rake

## Crane operation

Debris such as large trees and logs is collected by a timber grab or orange peel bucket.



Trashrack cleaner Feistriz Power Station  
Crane with orange peel bucket (no tree available for the picture)

## 2.2 Hydraulic jib trashrack cleaner

The open grab rake is lowered to the bottom of the rack and then moved to the rack bars. Then the rake is lifted sliding along the rack bars. The grab rake is closed - below or above the water surface, depending on the design – and lifted further. The trashrack cleaner moves with the lifted and closed grab rake to the debris deposit (concret pit, container, ...) and drops the debris.



Trashrack cleaner Leoben Power Station  
Grab Rake with debris

The operating sequences are as follows:

- Trashrack cleaner in home position
- Boom with grab rake in home position
- Boom with open grab rake is lowered to the bottom of the rack
- Boom with grab rake moves towards the rack bars
- Grab rake is lifted sliding on the rack bars and collects the debris from the rack
- Trashrack cleaner moves to the debris deposit
- The debris is dropped into the debris deposit (concrete pit or container or other)
- Grab rake returns to home position
- Trashrack cleaner moves to the next cleaning position

The trashrack cleaner returns to the debris deposit after each cleaning cycle. In the case of wide racks, the travel time between the cleaning position and debris deposit is considerable.

It would be difficult to complete an average cycle in under ten minutes.

#### Surface rake operation

The floating debris is pushed by the grab rake to the weir (same procedure as with the surface rake of the wire rope trashrack cleaner). For this procedure, the grab rake can be equipped with a hydraulic turning unit which can rotate the rake as much as 90 degrees in order to push more efficiently.



Trashrack cleaner Leoben Power Station  
Floating debris can also be collected during the trashrack cleaning operation

Most grab rakes are also designed to pick up oversized trees.



Trashrack cleander Leoben Power Station  
Picking up an oversized tree

### 3 Operative range

#### 3.1 Wire rope trash rack cleaner

Wire rope trashrack cleaners can be used for nearly unlimited rack-cleaning lengths. The lifting height of the trashrack cleaner in Itaipu, Brasil, for example, is 61,50 meters (vertical).

The inclination of the rack must be approximately 10 degrees or more to the vertical.

#### 3.2 Hydraulic jib trashrack cleaner

In recent times, the cleaning length of a hydraulic jib trashrack cleaner has been limited to 15 or 20 meters for techno-economical and architectural (height) reasons.

A rack with vertical rack bars can also be cleaned.

The range of the hydraulic jib trashrack cleaner can be increased by using telescope jibs, though the design of the apparatus will be more complex and the system weights much heavier.

## 4 Advantages, disadvantages

### 4.1 Wire rope trashrack cleaner

#### ADVANTAGES

Simple design (winch, control system)

Easy maintenance

Suitable for nearly unlimited lifting height and with deep intakes.

Flexible system because of the ropes (the rake can pass debris jammed in the rack)

The toothed cleaning plate of the rake also reaches the space between the rack bars and has a greater cleaning efficiency

Separate equipment for separate operations

Short cycle time

High availability because of simple design

#### DISADVANTAGES

Separate surface rake for floating debris necessary

Separate crane for floating trees, etc., necessary

### 4.2 Hydraulic jib trashrack cleaner

#### ADVANTAGES

Rake design can be optimized for the expected debris

No separate surface rake necessary

No separate crane necessary

#### DISADVANTAGES

Complex design (hydraulic system, control system)

Maintenance requires specialists

Operative range limited to the lifting height/intake depth of 15 to 20 meters

Catching of rake teeth between the rack bars is not possible because of the stiff boom system. So rakes without teeth are used.

Hydraulic components alternately above and under the water surface

Longer cycle time

Reduced availability because of complex design

## 5 Summary

Proven designs are available for both types of trashrack cleaners.

The classic wire rope trashrack cleaner most likely will continue to be used in large hydropower plants as well as for racks which require a long cleaning length.

The hydraulic jib trashrack cleaner, an "all-in-one"-machine, the dream of all plant managers, will continue to be used for small and medium hydropower plants with racks with limited cleaning lengths.

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