Patrind HPP

Investigation of a 20-year flood with suspended sediment load modelled with ground walnut shells.

The Patrind hydropower project features a weir site on the Kunhar River in Pakistan 120 km away from Islamabad towards the Northeast. The central block with a 44 m high gravity dam features two underflow and two overflow spillway bays for the diversion of high discharges.

The concept of sluicing high sediment loads, which are typical for the Himalayan region, is used as an approach for the sediment management. Thereby, the pool directly in front of the power intake, which is separated from the upstream reservoir by an overtopped cofferdam, is used as a natural settling pool.

The low flow velocities in the settling pool promote the deposition and storage of fine sediments up to 0.2 mm before reaching the power intake, where they could create abrasion during turbine operation. The sediment management concept schedules the flushing out of fine sediments through the underflow spillway once a year.

Additionally, a bypass tunnel of approximately 175 m length with an archway profile is implemented just upstream of the cofferdam in order to divert discharges higher than the maximal power plant discharge of 154 m^3/s as well as flush sediments to the downstream river reach. The scheme of the natural settling pool for trapping fine sediment and the bypass tunnel for diverting all sediments is referred to as “Optimal Hybrid De-Sander System (OHDS)”.

The VAW was commissioned by Saman Corp. in August 2014 with the hydraulic and sediment model investigations on the Patrind hydropower project with a physical model at a scale of 1:45. The model covers the gravity dam including the central block with two overflow spillway gates with integrated flap gates as well as two underflow spillway gates, the stilling basin, the power intake, the upstream cofferdam, the natural settling pool and the bypass tunnel. Upstream of the cofferdam, 300 m of the reservoir are modelled, while downstream of the weir, about 330 m of the river reach are reproduced.

The model investigations show that grains of 0.2 mm settle in the reservoir before they reach the power intake as long as a sufficient reservoir storage capacity can be maintained. In order to guarantee the long-term sustainability of the reservoir capacity, an appropriate operation regime is worked out, which includes the drawdown of the reservoir and the sluicing of large sediment loads during floods.

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