GEOTHERMAL EEL FARM IN SLOVAKIA

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Turčianske Teplice, a small town in west-central Slovakia, has written records of using thermal waters since 1281. It was then known as the village of Aqua Calida Teplica in Hungary. A spa was developed, and was visited not only by the Hungarian nobility, but also by the nobility from Poland and Austria. The town was, until around the turn of the century, part of the Austro-Hungarian empire. It then became part of the new state of Czechoslovakia in 1918, and since 1993, part of the Slovak Republic. It has been a spa town, using 46°C (115°F) geothermal waters in indoor and outdoor pools, as well as rehabilitation center for over 700 years (Figure 1).

Figure 1. The Blue Spa of Turčianske Teplice.

In 1992, an eel raising farm was started on the outskirts of the town and since 1994, it has been operated by the firm of Janex Slovensko. The farm, using a specialized water recirculation system, raises a species of migrating eels (Anguilla anguilla). A 220-meter (660-ft) deep well at 42°C (108°F) provides 3 L/s (48 gpm) to the facility for heating through a plate heat exchanger (Figure 2). This is the maximum flow permitted, so as not to influence the springs and wells at the spa about 1 km (0.6 mile) away. For this reason, the flow is monitored carefully by the state. A second geothermal well at 52°C (126°F) and 1,500 meters (4,900 ft) deep is used only as an observation well. Cold water, which is heated by the geothermal water, is pumped from wells near the Turiec River 2.8 km (1.7 miles) away at 8° to 12°C (46° to 54°F), depending upon the season, for use in the various holding or raising tanks.

The eels are caught in a Monte stage as Glass Eels, when they migrate from the sea to river estuaries. At that time, they weigh about 0.3 grams (0.01 oz) and are 2.5 to 3 years old. They are then shipped to be raised at the farm for 18 to 20 months where they reach a weight of 150 grams (5 oz)(Figure 3). The main aim of the farm is to raise the eels under optimum raising conditions. Under natural conditions, eels can grow to 1.5 meters in length, weight 5 to 7 kg and live 5 to 15 years. The eels are harvested in the spring and fall, mainly for export. Carp are harvested in between these seasons for stocking local ponds and reservoirs.

Figure 2. Plate heat exchanger inside the facility.

Figure 3. Eels feeding themselves in the holding tanks by turning the long rod to release the food..

The eel growing facility is housed in a two-story quonset-shaped building that covers approximately one hectar (2.5 acres)(Figure 4). The equipment is based on technology from Spain and uses a specialized filtration system that recirculates the water to the tanks.

Figure 4. Overview of the building..

The eels are raised in 60 circular tanks four meters (13 feet) in diameter that hold six cubic meters (1,585 gals) of water (Figure 5). Each tank will hold from 5,000 to 30,000 eels weighting 500 to 1,500 kg (1,100 to 3,300 lbs) depending upon the size. The heated water is supplied to these circular tanks at 25°C (77°F)

Figure 5. View of the holding tanks.

Freshwater is brought in from the wells near the Tureic River and passes through a small plate heat exchanger where it is heated by the geothermal water (Figure 6). The geothermal water is then wasted, and the waste water from the tanks, in most part (90%) filtered, biologically adjusted and enriched by oxygen, and then goes back into the holding tanks (Figure 7). The remaining 10% is treated in a purification device (COV) and disposed to a stream. The disposal is permitted and monitored by the state.

The market eels are harvested monthly and shipped by truck to Holland and Denmark. Only about one percent of the harvest is sold locally, as it is not a normal part of central European diet. Approximately, 50 tonnes (55 tons) are shipped annually at a selling price of about US$ 8.90 per kg (US$ 4.00 per lb).

The facility, which operates 24 hours per day, employs eight people, four electricians and four biologists.

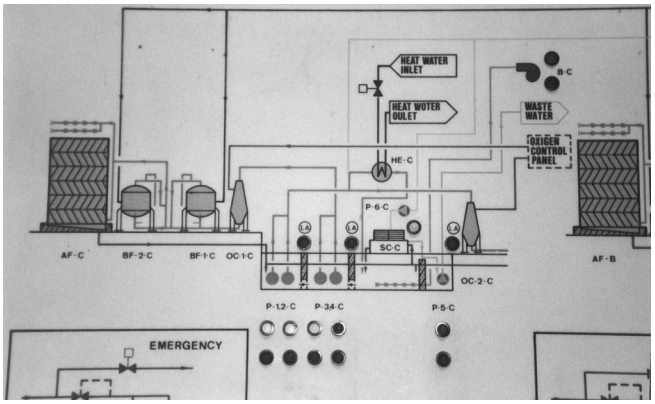

Figure 6. Diagram of the water flows in the facility.

Figure 7. Filtration tanks.

The economy of the eel raising facility is influenced by the temperature of the water in the holding tanks. The volume and ability to keep the temperature constant is dependent upon the geothermal water which is used for heating. The 3 L/s geothermal flow is not sufficient in the winter months; thus, there is a decrease in the eel growth rate. As a result, the size of the facility is constrained due to the limitation of the geothermal flow.

One proposal to increase the geothermal well flow is to produce from the deeper well at 52°C (126°F) and inject into the shallower 42°C (108°F) well. This would hopefully recharge the reservoir and minimize the impact on the nearby spa springs and wells. In addition, since the proposed production and injection wells are at different horizons, this should reduce or eliminate thermal breakthrough. Using the higher temperature well, a greater ΔT could be extracted, keeping the flow at a minimum or a greater flow could be used, since recharge is proposed.

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