Food & drink

Shrimp farming – a high water demand business

The development of intensive shrimp farming business in the last decades has created a need to design special features for seawater pumping. High water demand, extreme corrosion due to salt water, and unstable terrain conditions to place civil works are just some of the design challenges for ETEC engineers.

A shrimp farm is an aquaculture business for the cultivation of marine shrimp or prawns for human consumption. Commercial shrimp farming began in the 1970s, and production increasingly matched the market demands of the US, Japan, and Western Europe. The total global production of farmed-shrimp reached more than 1.6 million tons in this decade, representing a value of nearly US$9 billion. About 60% of farmed-shrimp is produced in Asia, particularly in China and Thailand. The other 40% is produced mainly in Latin America, in countries like Mexico, Ecuador, Honduras and Nicaragua, where the business has grown quickly in the last decade.

Shrimp farming has changed from traditional, small-scale businesses in Southeast Asia into a global industry. Technological advances have led to growing shrimp at ever higher densities, where production cost efficiency has become one of the most important fields for business.

Shrimp farming emerged in the 1970s as an economically viable alternative to satisfy growing market demands that had surpassed the capacity of the wild shrimp fishery. Subsequently, the subsistence of old farming methods were rapidly replaced by the more intensive practices of an export-oriented business.

Higher water demand

Water exchange methods for shrimp farms vary depending on the type of farming (extensive, semi-intensive or intensive), where water recirculation could vary from 2% to 25%. For example, in a typical extensive farm of 250 hectares, there are several ponds that continuously require up to 20% of water recirculation in one day. The total water amount in the farm will be about 3,500,000 m^3 of water, and the re-circulated will be 700,000 m^3 of water per day.

The amount of water required will vary according to tide levels and hours of operation. A farm achieving the water exchange in a 12 hour shift would require 16.2 m^3/s.

To understand the magnitude of the amount of water pumped in just one farm, let's

Figure 1. Aerial view of shrimp farm in Malaysia.

Table 1. General specifications of available floating pumps						
Impeller Diameter		24 in	30 in	36 in	42 in	48 in
Flow Rate	GPM	19,000	30,000	40,000	57,000	79,000
	LITERS/SEG	1,200	1,850	2,500	3,600	5,000
Minimum Submergence		1,30	1,30	1,40	1,50	1,50
Maximum Dynamic Head (TDH)	MTS FEET	16 52.5	16 52.5	16 52.5	16 52.5	16 52.5

compare it with the estimated average amount of potable water consumed in some of the world´s major cities:

- New York: 46 m^3/second (733,000 gpm)
- Madrid: 35 m^3/second (555,000 gpm)
- City of Mexico: 55 m^3/second (951,000 gpm)

This kind of flow rates at relative low heads, can be cost/efficiently handled with axial flow (propeller) pumps.

Sea water corrosion

Axial pumps are commonly used for flood control, wastewater management, irrigation in agriculture and several other applications. Due to extreme conditions in shrimp farms, where all the water is pumped from the sea, the regular body for pumps made in steel was less durable. The traditional material to manufacture axial flow pumps for this application was naval carbon steel.

Stainless steel could be a solution for manufacturing the body of pumps, but the high price makes it nonviable.

A couple of years ago, ETEC decided to use its knowledge in the naval field, based on the experience of producing composite materials, and developed a new pump made with polyester and reinforced fibre glass for the pump´s body. It kept the bowl elements in 304 or 316 stainless steel (shaft, bushings, propeller)

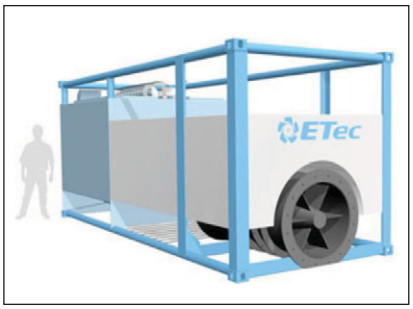

Figure 2. ETEC 48 in patented floating pump.

The main advantages of the fiberglass body pump are:

- Durability
- Low maintenance rates
- Lighter equipment that is easier to manipulate
- Inner surface with lower friction which decreases the pressure losses, and increases efficiency.

Axial flow floating pump features

- Constructed under the dimensions and exact measurements of a 20 ft container, facilitating transportation of the unit.
- Flotation is accomplished with the construction of one Fiber-Glass tank, with walls 9 mm thick. Fiber glass compartment is filled by Low Density Polyurethane foam for security and submerged engine compartment made in ASTM 131 Grade-A marine steel, 8 mm thick. The engine compartment is equipped with an automatic electric bilge pump.
- The engine compartment is equipped with two access hatches for maintenance and two ventilation ducts with mechanical ventilators to ensure adequate compartment temperature.
- The diesel engine is equipped with an industrial silencer.
- The pump's bowl is constructed under ASME norms, out of certified 3/8 in Grade-A steel plates. All the welding personnel is periodically certified by Lloyd's Register of London, under ASME Norms, Code Section IX.
- The impeller is austhenized through heat treatment and has stainless steel 304 cast blades for the impeller.
- A stainless steel 304 shaft, water lubricated is installed inside an enclosing tube for garbage protection and structural reinforcement.
- The water lubricated pumps have exchangeable stainless steel 304 sleeves installed on the shaft to protect it from premature wear.
- A stainless steel 304 wear-ring protects the area influenced by the impeller.
- The intake is protected with a metal grid made out with of steel pipe that serves as keel cooler for the diesel engine.
- The unit (container) is installed inside a metal frame, made of 4 in diameter pipes, and 6 in × 6 in × ¼ in angles, all welded to corner plots.
- An external control panel is installed on deck for easy operation without having to access engine compartment (diesel option).

Figure 3. ETEC 48 in floating pumps installation for a project.

Figure 4. ETEC 48 in floating pumping station.

Impossible terrain

Another challenge presented several years ago, was the difficulty in building a station in some shrimp farm areas where the specific conditions of the terrain made it very unstable to support the foundations of any structure.

Some stations were built using deep pillars, but over time the structure moved and endangered the operation of pumping equipment, frequently forcing repair works.

In response to this challenge ETEC engineers developed axial floating pumps that were initially conceived for a flow rate of 48 in 5 m^3/sec, with a 36 in to 48 in diameter, using diesel or electric motors depending on the application.

Power varied between 250 hp to 525 hp depending on the total dynamic head required. The floating pump challenges conventional pump stations that are expensive, time consuming, and troublesome to build.

After the development of the floating equipment, another market became suitable for

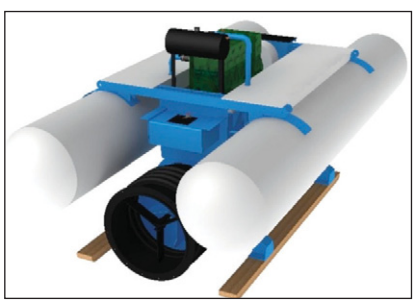

Figure 5. Patented VL version 36 in floating pump.

Figure 6. Lighter version 36 in floating pump in a shrimp farm.

this application. This was due to it being seen as a cost/benefit solution for flood control projects, agricultural irrigation districts, and other water-management projects.

- No infrastructure required for installation
- Fast installation and start up
- Simple relocation of equipment to different pumping zones.
- Intake water is of highest possible quality since suction remains near the surface
- Constructed with lightweight high resistance materials with low cost and simple maintenance in mind.
- Flexible coupling and discharge pipe in HDPE (high density polyethylene) to absorb fluctuation in the intake water level during the operation.

Lighter version

Due to the success of the container size floating pump and fewer flow requirements for several projects with customers, a new floating pump from 24 in to 36 in diameter was developed. The VL pump is a low cost model and it can reach total dynamic heads below 8 m in standard versions.

The VL pump has been used for several shrimp farm projects, but also has been applied in important agriculture projects for irrigation and drainage, and in municipalities' to take water for aqueducts.

Currently, ETEC is present in more than 23 countries, with pumping stations working in places as Holland, New Caledonia, Saudi Arabia, Central, and South America. The company aims to be a worldwide supplier of pumping solutions.

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