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## Help for homeless sea creatures

*Precast concrete units rebuild the aquatic environment*

**H**uman recreational activity, pollution and natural disasters have destroyed many natural coral reef systems in the world's oceans. Where natural reefs can't rebuild themselves quickly enough to prevent damage to beaches and fish populations, one environmentally sound solution is to build artificial reefs with Reef Balls, dome-shaped hollow concrete balls with holes in them that mimic natural coral reefs.

Some ready-mixed and precast concrete producers have gained goodwill and an outlet for waste concrete by becoming, or partnering with, Reef-Ball licensees.

Tim Guscette, plant manager at Southdown Inc.'s Concrete Products Division in Sarasota, Fla. (formerly Florida Mining and Materials), notes that it's an excellent way to put to good use ends of loads and rejected loads the company would otherwise have to dispose of. This is because producers like Guscette can cast Reef Balls, somewhat rough and imperfect by design, with almost any waste concrete, as long as it's adjusted with the required admixtures and remixed. "It's a great public relations thing for us to do, as well as a positive thing for the environment," says Guscette.

### **Beach balls to Reef Balls**

Often, artificial reefs are sunken ships, tires, old train cars or crumbled bridges. Todd Barber, now president of the Reef Ball Development Group Ltd. (RBDG), a volunteer environmental organization, got tired of scuba diving around these trash heaps. Wishing to see more long-lasting, environmentally friendly reefs, he came up with the idea for Reef Balls.

Barber and his buddies began by trying to cover beach balls with chicken wire and concrete with the plan of floating them out to sea, popping the balls and letting the shells sink to the bottom. This is essentially how the Reef Ball works.

A Reef Ball is made by placing concrete into a fiberglass mold that contains a central inflatable buoy surrounded by inflatable balls of various sizes around which concrete is placed, forming the holes. Though the basic shape is uniform, no two Reef Balls are identical because the holes are placed and sized manually on each form. The internal buoy can be left in place to provide flotation for towing the ball out to sea by boat, then deflated slowly to allow a controlled descent for precise placement by divers. This placement method makes repairs to existing natural reefs possible. It's also possible to deploy Reef Balls by less precise methods such as dumping them off a barge, dropping them from a crane and even flying them out to sea by helicopter.

Reef Balls represent only one of the reef-building products available. Pallet Balls, Bay Balls, Lo-Pro Balls and Oyster Balls offer variations on the size and shape. Miniature 6-inch model Reef Balls are also available and make good reefs in saltwater aquariums.



All photos courtesy Reef Ball Development Group Ltd.

*Reef Balls awaiting deployment for a beach restoration project in the Dominican Republic.*

### **Why concrete?**

The use of concrete to construct artificial reefs offers several advantages. Reef Balls are heavy enough to be stable on the sea floor (they have withstood hurricanes without moving) yet provide multiple entrances and internal cavities for shelter. Concrete contains no toxins and the surface of the balls can be rough and textured to enhance marine growth. Reef Balls carefully designed for the local environment should last hundreds of years.

The concrete mix design for Reef Balls is tailored for each location and application. Design criteria for saltwater deployment might include:

- 4500-psi compressive strength
- Type II Portland cement
- Microsilica ( 9% to 10% of the cement volume)
- 7- to 9-inch slump obtained with a high-range water-reducing admixture (superplasticizer)
- Sugar water surface retarder on mold surfaces
- 4% air entrainment
- Polypropylene fibers

The microsilica helps to create highstrength, abrasion-resistant concrete with low permeability. Adding microsilica also lowers the initial pH of the concrete, promoting the growth of desired marine life such as larval corals. It reacts with the hydration byproduct, calcium hydroxide, to reduce the surface pH from around 12 for normal concrete to one closer to that of natural sea water. Although this reduction would happen normally under water over three to six months, the initially high pH would kill some marine species and allow less-desirable resistant species such as barnacles to take over.

The superplasticizer makes the concrete fluid enough to flow around all the inflated objects. The producer sprays sugar water onto the mold surfaces before casting to retard surface setting. This keeps the outside half inch of the concrete from setting; the producer can then expose the aggregate by rinsing the surface with a hose. The resulting uneven surface texture encourages the growth of algae, barnacles and coral.

An air-entraining agent may also be used for its surface texture benefits. It creates tiny pockets in the concrete that pit the Reef Ball's surface, offering miniature marine organisms places to easily attach themselves.

Reef Balls normally contain no reinforcing steel because iron is biologically active, serving as a nutrient for algae, which outgrows the more desirable hard corals. When rebar is necessary, a calcium nitrite-based corrosion inhibitor must be used. The producer may use polypropylene fibers to reduce microcracks that can occur in molds with inflatable parts in hot weather or where the mold temperature is uneven (as when the sun shines on one side).

While most Reef Balls are used in saltwater applications, they are occasionally used in fresh water over sandy areas to provide a place for fish to spawn. For freshwater applications, a standard concrete mix with only the superplasticizer added is suitable. The microsilica, entrained air and surface retarder are not necessary.



*Reef Ball molds and demolding of a Reef Ball reveals its Swiss-cheese-like holes and internal inflated balloon.*

### **Authorized manufacturers**

RBDG sells the molds, provides clients with concrete specifications, helps clients through the permitting process, and licenses manufacturers who market, make and transport the balls. Often, producers work in partnership with RBDG's other authorized firms, providing a place to build the balls and donating materials while volunteers provide the labor. Barber notes that while RBDG is always looking for additional licensees, it's essential that interested parties exhibit a genuine concern for the environment before they will be seriously considered.

Roman Stone Construction Co. in Bay Shore, NY, now in its 95th year of precast pipe operations, has also become a licensed Reef Ball manufacturer. General Manager Tom Montalbine believes concrete is a good choice for reef building. "Concrete and concrete production in general could be considered environmentally sound because the raw materials are all natural," he says. Montalbine's personal interest in scuba diving gives him an extra reason to appreciate the work of the RBDG and helped spark his initial interest in Reef Balls.

RBDG uses the royalties it receives from its authorized manufacturers to help fund the Reef Ball Foundation, a nonprofit group that supplies free molds and support to other nonprofit and research groups who wish to study or help create Reef Ball reefs. Reef Balls have been deployed off all U.S. coasts, and international use is widespread and growing. **-M. Wynne Palmer**



*In only one year, significant sponge and soft coral growth can be realized, as shown on this Bay Ball in the Florida Keys (left). Diver look at freshly deployed Reef Balls in Cancun, Mexico (right).*

**Web Link** - Extensive information about Reef Balls is also available on the Reef Ball Development Group's Web site: [www.reefball.org](http://www.reefball.org)

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