BREATHING *fresh air* INTO YOUR THERAPEUTIC POOL FACILITY

by Alison Osinski, Ph.D.

With proper facility design and maintenance, owners and managers in the growing arena of aquatic therapy can ensure the continued health of their staff.

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Aquatic therapy has traditionally been performed in single-user, draw-and-fill therapeutic whirlpool tubs. Today, therapy is provided in specially designed, multifeature, prefabricated therapy pools or in swimming pools expressly built for therapeutic activities. These special pools are being built not just by hospitals, rehabilitation centers and physical therapy clinics, but also by community-service organizations, retirement communities, and park and recreation districts.

By their very nature, aquatic therapy programs focus on the health of their patients. But what about the health of the therapists? Too often, poorly designed, operated and maintained facilities result in unacceptable air quality, which has adverse effects on therapists. In fact, therapists who spend their days working in indoor, warm-water therapy pools experience a disproportionate number of sick building syndrome, building-related illness, multiple-chemical sensitivity and hypersensitivity disease problems. Fortunately, the causes of facility air-quality problems can usually be identified, remedied and even prevented.

Causes of poor indoor air quality

Many indoor air quality (IAQ) problems arise because therapy pools are not just little swimming pools; they are actually more like big spas. As a result, the design and maintenance of a pool's sanitation/oxidation and hydraulic systems must take into account the elevated water temperatures and high bather-to-water-volume ratios of therapy pools.

Another reason serious IAQ problems exist in therapeutic-pool facilities is that the special needs of these facilities are not addressed during the design phase. Because many architects and engineers are not familiar with the patient and staff demands that will be placed on the facility, the heating, ventilating and air-conditioning (HVAC) systems for these facilities may be inadequately designed for the task.

Attempts to save energy also have greatly affected natatoriums. As they become better insulated, windows are sealed and forced-air systems are replaced by closed-loop energy-recovery systems that recycle a portion of the air. Additionally, dissipated pool chemicals, cleaning agents and building materials that emit volatile organic compounds contribute to the air pollution problem.

So how can you ensure that the air in your therapeutic aquatic facility is healthy? The most important steps to take are during the design phase of the air-handling system, and the primary factors to address during design are air temperature, relative humidity, ventilation rate and air-distribution pattern.

Air temperature

Air temperature standards recommend that thermal environmental conditions be acceptable to at least 80 percent of the occupants (ASHRAE 1992). To ensure that your conditions are acceptable, always maintain air temperatuure at 2 to 7 F higher than the pool-water temperature.

Remember that the water temperature depends a great deal on the types of therapeutic activities being conducted and the level of intensity of the activities. For example, multiuse, low-intensity aerobics should be performed in water temperatures of 82-

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86 F and stretching and range of motion exercises at 86-88 F. Most therapeutic activities are performed in water temperatures in the 90-94 F range, with simple water soaking usually in the 100-104 F range.

Maintaining the air temperature at 2 to 7 F higher than the water temperature will prevent heat and moisture from being drawn from the pool into the surrounding air. Pool covers are another way to prevent the heat from the pool from escaping. As additional benefits, insulating pool covers prevent dirt and debris from entering the pool; reduce maintenance time, heating costs and chemical dissipation; conserve make-up water; lessen the required ventilation rate; and help prevent rusting and deterioration of structural components.

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Relative humidity

Relative humidity is the percentage of moisture in the air relative to the amount of moisture the air could hold if saturated at the same temperature. ASHRAE Standard 55-1992 states that relative humidity of all occupied spaces be maintained between 30 and 60 percent (ASHRAE 1992).

For the best comfort and health of your staff and patients, as well as for the durability of the facility and its equipment, dehumidify the air to between 50 and 60 percent during summer months and between 30 and 50 percent in the winter months (or when outside temperatures drop below 45 F). Dehumidifying to these levels prevents condensation caused by high humidity; excessive condensation can cause extensive damage to the interior surfaces and components of your facility.

High relative humidity levels are also favorable to bacterial and biofilm growth. Conversely, if your humidity levels are consistently too low, you may begin hearing complaints of dry skin, chapped lips, sore throats and nose bleeds.

Ventilation rate

The exact amount of outside air brought into your facility is determined by the ventilation rate. Proper ventilation rates are based on area, space function and user loading (ASHRAE 1989).

The ASHRAE standard recommends that fresh air be introduced at a minimum rate of 0.5 cubic feet per minute (cfm) per square foot of facility area, plus another 15 to 25 cfm for each person in the space. Carbon dioxide levels should be maintained below 0.1 percent or 1,000 ppm. For example, a 10,000-square-foot therapy facility (including pool, deck space, chemical rooms, pump rooms, locker rooms and auxiliary spaces) with a maximum user capacity of 40 would require fresh air at a rate of at least 5,600 cfm [(10,000 x 0.5) + (15 x 40) = 5,000 + 600 = 5,600].

Inadequate oxygen levels over the pool can make it difficult or sometimes impossible to reach chlorine breakpoint. Water agitation or use of hydrotherapy jets can cause endotoxins that have not been destroyed through oxidation or breakpoint chlorination to be released into the air.

It's important to keep in mind that the higher the level of pool activity, the higher the level of water temperature and water agitation. These both lead to greater dissipation of chemicals into the air. By introducing more outside air into

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Specific IAQ illnesses

Many illnesses have been associated with poor indoor air quality. Here are five that have been identified and defined:

Sick building syndrome

Sick building syndrome is an indoor air quality problem in which the source of the illness cannot be positively identified. Twenty percent or more of building occupants display symptoms, and symptoms of the illness last two or more weeks. Symptoms of sick building syndrome usually disappear, or at least subside, when the person leaves the building for a period of time.

Building-related illness

Building-related illness is similar to sick building syndrome, but the cause of the symptoms is known and can be traced to a specific source. A distinguishable set of symptoms, shared by those affected, can be identified.

Multiple chemical sensitivity

Multiple chemical sensitivity (MCS) is an illness that occurs when individuals become extra sensitive to a number of chemicals at very low concentrations. There is some debate in the medical community whether MCS is a true physical illness or whether symptoms are actually psychosomatic.

Hypersensitivity diseases

Hypersensitivity diseases such as asthma or rhinitis are results of allergic responses to animal antigens. Hypersensitivity diseases are common among competitive swimmers and full-time indoor pool employees.

Hypersensitivity pneumonitis

Hypersensitivity pneumonitis (HP) is a rare and serious disease caused by exposure to and inhalation of high levels of aerosolized endotoxins. If subjected to continual exposure, HP can cause progressive lung damage. Problems develop due to incomplete oxidation of organic waste products in the water and inadequate ventilation of contaminants.

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the facility, you can ensure that air contaminants stay at a minimum. At least six, and preferably eight, complete air exchanges should occur every hour around the clock.

Air-distribution pattern

Perhaps you've done the math and have determined that your facility has the proper ventilation rate. You're on the right track, but keep in mind that simply having the proper rate does not ensure healthy air in the breathing zone. A common design error in therapy facilities is the improper location and placement of ductwork.

It may be less expensive initially to install all the ductwork at ceiling level, but in the long run it can be a costly mistake. Unless the fresh air is supplied at a very high velocity, ceiling-level ductwork will almost guarantee that little fresh air will ever reach the area directly over the pool. Drafts, thermoclines (layers of air of different temperatures) and temperature changes may develop, and the warm air supplied from the ceiling level can cling to the ceiling and be vented out of the facility. Air should always be supplied to the pool area from near deck level.

It's a good idea to regularly sample and test your facility's air distribution pattern. Gather air samples from an area 6 inches above the pool water surface using volumetric pumps or direct-reading electronic dosimeters. Sample the personal breathing zone of therapists by having them occasionally wear personal dosimeters, detection tubes or chemical monitoring badges. You might try smoke tubes to evaluate air motion or an air-velocity meter or anemometer to measure air velocity (feet per minute). Talk to your HVAC specialist or mechanical engineer about measuring air flow (cubic feet per minute) with an air-flow meter or a balancing hood and adapter.

Air-sampling devices range in price from a couple of dollars for personal detection devices to several thousands of dollars for complex area dosimeters. The devices can be found in most safety-supply catalogs.

In addition to health-related concerns, an improperly designed HVAC system can cause corrosion of metal components in the

Indoor Air Quality Checklist

While there are numerous steps to take to ensure proper indoor air quality, the following basic checklist includes the most important provisions to maintaining optimum air quality:

- ____ Maintain air temperature 2 to 7 F above pool water temperature
- ____ Cover the therapy pool when not in use
- ____ Maintain relative humidity between 40 and 50 percent
- ____ Ventilate at a rate of 0.5 cfm per square foot of facility area, plus 20 cfm for each anticipated bather or spectator
- ____ Ensure eight complete air exchanges per hour
- ____ Distribute air from low to high and across the surface of the pool
- ____ Cross ventilate—introduce and exhaust air on all four sides of the pool
- ____ Comply with OSHA's "Permissible Exposure Limits" and the American Conference of Governmental Industrial Hygienists' "Threshold Limit Values" exposure standards
- ____ Maintain CO_2 levels below 0.1 percent or 1,000 ppm
- ____ Sample and analyze natatorium air quality
- ____ Make sure the natatorium has a positive pressure to allow pollutants to travel from positive to negative pressure areas
- ____ Design to avoid drafts, thermocline formation or temperature gradients

Common health symptoms resulting from poor IAQ

What's the first sign that your facility may have indoor air quality problems? It will probably be health complaints from your therapists. Be on the lookout for the following common symptoms among indoor-pool therapists:

- Chronic respiratory problems such as sinus congestion, nosebleeds, asthma and sore throats
- Drowsiness, fatigue, irritability, headaches and inability to concentrate
- Persistent viral and bacterial infections
- Skin rashes, dry skin, hypersensitivity diseases, and other dermatological problems

It's important to record all complaints made by patients or staff related to air quality. If you think you might have a problem, collect biological specimens of blood, tissue, urine or exhaled air from therapists. If symptoms persist, take any necessary steps to prevent overexposure, including restricting the number of hours a therapist works in the pool area.

facility, resulting in ceiling damage and collapse, or more serious structural problems. Unfortunately, ceiling collapse is an ongoing problem in natatoriums; regular ceiling inspections are highly recommended.

New tools of the trade

As the population continues to age and the benefits of aquatic therapy become recognized by both the general population and the medical establishment, the demand for therapy pools will likely increase. Many aquatic facility directors who've never given a second thought to relative humidity and air distribution may soon find themselves studying HVAC systems and purchasing personal dosimeters.

While the number of pools, ease of accessibility and types of programming at your therapeutic facility are as important as ever, the right decisions during the design phase, as well as proper system maintenance, may be the keys to your facility's success.

References

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) (1989). Standard 62-1989, *Ventilation for Acceptable Indoor Air Quality*. Atlanta.

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