Leisure Noise.

The Leisure Industry has long-suffered from self-generated noise, swimming pools and large multi-purpose halls being the prime culprits.

High noise levels are not only unpleasant for the public and staff alike but also create a safety hazard. Instructors cannot be heard, announcements over the public address system are drowned out and, most serious of all, the high noise level make it virtually impossible to identify a swimmer in trouble by ear alone.

Why should large rooms with cleanable, vandal proof surface finishes be so noisy?

To understand the problem imaging a source, say a hand clap or scream at point S in the room, as shown in Figure 1.

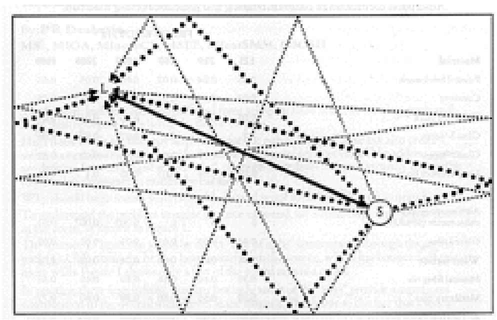

Figure 1.

The listener ‘L’ hears the sound by direct "line of sight" transmission through the air via path (1). Unfortunately, he also hears sound from the source, which has bounced off one or more walls. Figure 1 shows only a few of the sound rays in a room.

In practice, there is an infinite number but only some of the "rays" provide a significant contribution to the overall sound level at the listener. This is due to the fact that a sound "ray" which has undergone many reflections from the room surfaces will have lost part of its energy at each reflection and will have travelled a long way.

Figure 2 shows how the listener will hear the sound as several echoes, however, because of the number of echoes, the resulting impression is of a ‘reverberation’ or ‘hanging-on’ of the sound.

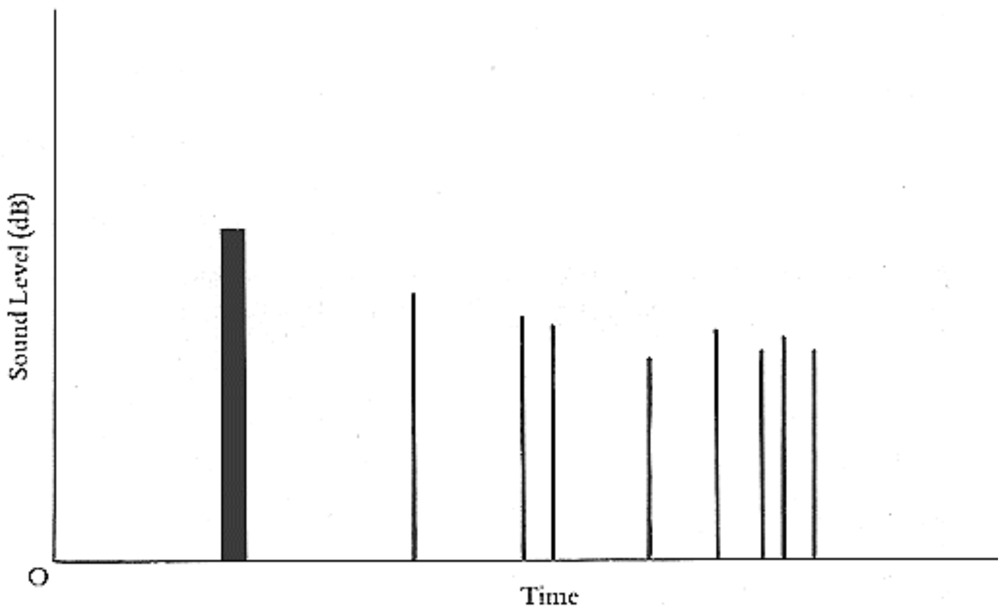

Figure 2.

Let us now imaging the source is a continuous noise.

Initially, the direct sound arrives and, subsequently, the reflected sound field, increases as the various reflections arrive. After a short period of time a balance is reached and the sound pressure level stabilises, due to the reflected energy. This is, of course, a very simple model and in a real swimming pool we have many sources intermittently producing sounds which are spread over the entire room and this produces an even more confusing sound field.

How then can we reduce the noise?

Clearly a dramatic reduction could be achieved if we only had the direct sound and the echo, or reverberation, was eliminated completely. This is not a realisable target but it is possible to dramatically reduce reverberation.

The reverberation time of a room is the time taken for a sound to decay by 60 dB after it is stopped. It can be calculated by using the following formula:-

$$\text{Reverberation Time, } RT60 = 0.163\ V / A, \text{ seconds.}$$

Where V is the room volume in cubic metres and A is the total absorption in the room in Metric Sabines.

Immediately we can see that large volumes produce long reverberation times but we cannot make a swimming pool or indoor tennis court any smaller. Also, rooms which have no absorption will have long reverberation times. If we can increase the total absorption in a room we can shorten the reverberation time and hence, reduce the reverberation noise, irrespective of the size of the hall.

Earlier I mentioned that every time sound bounces off a surface some of the energy is absorbed. The harder the surface the less energy is absorbed and the more reflected, conversely, soft surfaces absorb sound more efficiently. The efficiency with which the sound is absorbed is measured using the ‘absorption coefficient’.

The absorption coefficient = The amount of sound absorbed / The amount of sound incident.

Now, if the absorption coefficient is 0, the material is a perfect reflector

and if it is 1, the material is a perfect absorber.

The amount of absorption ‘A’ is calculated by multiplying the absorption coefficients by the surface area of the material. This can be done for every surface in a hall and the total room absorption can be obtained by simple arithmetic.

Since the room volume is know, the reverberation time can now be calculated. For many halls and swimming pools it will be as long as three or four seconds. The maximum recommended reverberation time for leisure facilities of this type is 1.2 seconds and, ideally, it would be a good design basis to aim to achieve one second or less.

Some simple arithmetic will soon reveal that very large areas of a surface finish having a high absorption coefficient will be required to achieve the desired results. Clearly the ceiling and/or walls are the immediately obvious choice and the photograph on page four (courtesy Ecophon Ceiling Systems) shows a special acoustic ceiling fitted in swimming pool.

The choice of materials for such an application is critical, since the following criteria must be met for it to be viable in the Leisure Industry:-

1. The treatment must be easy to install and maintain
2. It must offer high absorption coefficients
3. It must be washable and not prone to impact damage
4. It must be an inherently strong material
5. It must be unaffected by moisture and humidity.

A number of companies produce ceiling tiles and wall panels with some of these properties but, be far the most comprehensive range is that offered by Ecophon Ceiling Systems.

Ecophon systems are now available that can be pressure washed and, the most impressive part of the Ecophon literature, is that they publish actual laboratory test data for the absorption coefficients of all their products. This means that, by using the simple formulae quoted earlier in this article, anyone can calculate the effect of an acoustic ceiling or wall panelling on the reverberation time.

Unfortunately, it is a tedious calculation because it has to be done for each of the standard measuring frequencies (i.e. 125, 250, 500, 1000, 2000 and 4000 Hz). To make the calculation possible the absorption coefficients of a number of building products are shown in the table :

Material.	125	250	500	1k	2k	4k
Painted brickwork.	0.05	0.04	0.02	0.04	0.05	0.05
Concrete	0.02	0.02	0.02	0.04	0.05	0.05
Plaster on brick	0.03	0.03	0.02	0.03	0.04	0.05
3/4mm Glass	0.2	0.15	0.1	0.07	0.05	0.05

Glass >4mm	0.1	0.07	0.04	0.03	0.02	0.02
Lino or Rubber floor.	0.02	0.04	0.05	0.05	0.1	0.05
Air absorption per cubic metre	0	0	0	0.003	0.007	0.02
Glazed tiles	0.01	0.01	0.01	0.01	0.02	0.02
Water surface	0.01	0.01	0.01	0.01	0.02	0.02
Mineral fibre tile	0.3	0.4	0.45	0.55	0.65	0.65
Metal tray tiles,perforated with absorber on top.	0.2	0.55	0.8	0.8	0.8	0.75
Ecophon glass fibre tiles	0.4	0.9	1.0	0.9	1.0	0.95
Ecophon wall panels	0.25	0.7	1.0	1.0	0.95	0.9

Where such treatments have been installed at various pools and sports facilitates around the country, the results have been a dramatic improvement in the whole environment and these results have been widely acclaimed both by the staff and the general public.

There is no longer any reason to endure the problems associated with high noise as there is a very simple cure!

Rugby Swimming Pool, Photograph courtesy of :

Ecophon International Ltd,, Old Brick Kiln,

Ramsdell, Basingstoke,, Hampshire, RG26 5PP.

Tel : 01256 850977, Fax : 01256 850600.

For further information please contact:
PDA Ltd, Alder House, Willow Tree Park, Booths Lane, Lymm, Ches
hire WA13 0GH Tel: 01925 759380

Or visit **http://www.pdaltd.com**