

Talk to Café Scientifique Romsey

January 23rd 2020, Audience of 140

The Power of Bubbles.

Dr Nikhil Mistry, MEng PhD MIOA
Research Fellow in Underwater Acoustics
National Oceanography Centre, European Way
Southampton, SO14 3ZH

<https://www.southampton.ac.uk/oes/about/staff/nm2f18.page>



Gas bubbles are some of the most powerful naturally occurring entities in liquids. When they are rushed into the ocean, through breaking waves, we can use their sounds to quantify how much our seas absorb carbon dioxide. Those same bubbles can confound even the most sophisticated sonar, yet dolphins are able to hunt in bubbly water with ease. How do they do it? The power of smaller bubbles is exploited in medicine, tearing apart tumours from the inside, clearing blood clots to save lives and acting as messengers in targeted drug delivery. At high amplitudes of pulsation, a bubble can generate several thousand Kelvin, when under compression. The power of the sun, in the palm of our hands.

Bubbles are a bit like bells; the small ones can make very high-pitched sounds and the larger ones make low-pitched sounds. We don't need clever maths to prove this, all we need is a glass of water, with a straw, and a can of fizzy drink. When we open the can, there is a high-pitched sizzling sound, because it has tiny bubbles. When we blow into the straw, in the water, we get a low-pitched gurgling sound from all the big bubbles we have created. It's this relationship between the size of the bubble and the sound it makes that allows for some powerful technology to work.

Not only does a bubble radiate sound, but it also absorbs sound. It has the ability to absorb the same sound it makes/radiates. We can use this in the oceans to absorb noise from construction, to avoid disturbing marine mammals nearby. The same property can be used to quantify the amount of carbon dioxide absorber by oceans when plunging breaker waves crash volumes of air into them. The air fragments into bubbles, under the water surface, and we can listen to those sounds to determine the sizes of the bubble and the number of each size present.

Bubbles are a useful tool in medicine too; we can use them to tear apart tumours, blast kidney stones and destroy stubborn films of bacteria. By exciting the bubbles, with the sounds they like to vibrate at, they begin to dance and shimmer. This motion is enough to break apart any material around them, be it mud, human tissue or bacteria. Sometimes, drugs can be used as messengers, to deliver drugs to specific part of the body. When they reach the desired location, a pulse of ultrasound forces them to release the drug and the motion of the bubble enhances the rate of drug absorption.

What was originally a seemingly inert natural entity suddenly reveals itself to be a power tool in medicine, studying the ocean and earth and the built and natural environment.

More information

https://www.southampton.ac.uk/engineering/research/impact/bubble_acoustics.page