Physic Abhishek Roll No 32

Engineering Physics (Lovely Professional University)

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SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

PHY-110

CONTINUOUS ASSESSMENT -2

TITLE: APPLICATIONS OF ULTRASONIC SOUND

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Applications of Ultrasonic Sound

Abhishek Kumar - 32

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Ultrasonic sound refers to sound waves with frequencies above the audible range of human hearing, typically above 20 KHz. These sound waves have unique properties that make them useful in a variety of fields, from medical diagnostics to industrial applications. Here, we will explore key applications of ultrasonic sound in different sectors.

1) Medical Applications

(a) Ultrasonography (Ultrasound Imaging)

One of the most well-known applications of ultrasonic sound is in medical imaging, particularly ultrasonography, commonly referred to as ultrasound imaging. It is widely used in prenatal care to visualize and monitor the development of a fetus. The technique works by transmitting high-frequency sound wave

into the body, which are then reflected off tissues, organs, and bones. These reflected waves are converted into real-times images, allowing doctors to visualize internal structures without the need for invasive surgery or exposure to harmful radiation unlike X-ray

Beyond obstetrics, ultrasound is also used for diagnostic imaging in cardiology (echocardiography), abdominal imaging, and musculoskeletal evaluations. Doppler ultrasound is a specific application that measures blood flow and is invaluable in detecting conditions such as blood clots, blocked arteries, and heart valve defects.

(b) Therapeutic Applications

Ultrasonic sound is also employed for therapeutic purpose. High-intensity focused Ultrasound (HIFU) is used to treat cancer by focusing ultrasound waves on a specific region of the body, increasing the temperature and effectively destroying abnormal tissue. This method is non-invasive and minimizes damage to surrounding healthy tissues, making it a

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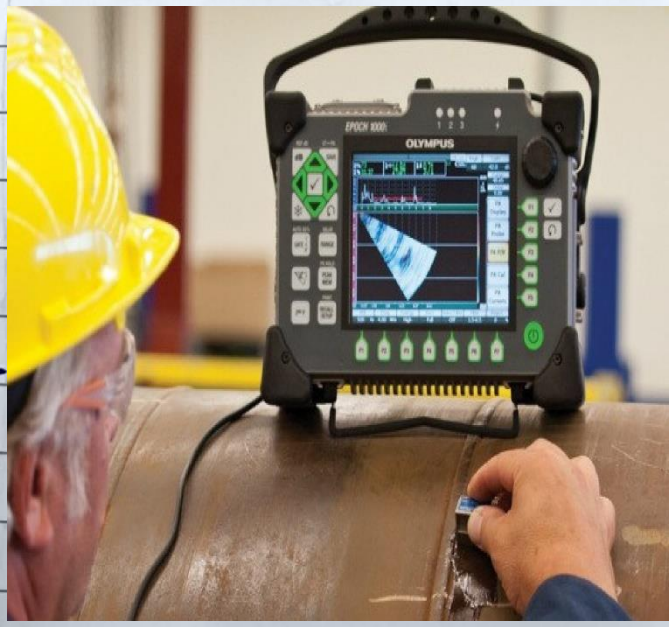
a promising treatment for tumors in the prostate, liver, and other organs.

Physiotheraphy also employs ultrasound to treat soft tissue injuries, improve circulation, and promote healing. The vibrations from the ultrasound waves enhance cellular activity, reduce pain, and accelerate the healing of injuries such as sprains and muscle tears.

2.) Industrial Applications

(a) Non-Destructive Testing (NDT)

In industries such as aerospace, automotive, and manufacturing, ultrasonic sound is crucial for non-destructive testing (NDT). This technique is used to inpect meterials and components for defects. like cracks, voids, and corrosion without damaging the object bening examined. High-frequuecy sound waves are sent through the mete-rial, and the way these wave reflect and travel through it can reveal int-ernal imperfections. This



esures that structures like airplane wings, pipelines, and machinery are safe and free from hidden flaws, improving both safety and longevity.

(b) Ultrasonic Cleaning

Ultrasonic cleaning is another significant industrial application, where ultrasonic sound wave are used to clean delicate object. Items are placed in a liquid-filled chamber, and ultrasonic waves create high-frequency vibrations that grenerate cavitation bubbles. When these bubbles collapse, they produce tiny jets of liquid that can dislodge dirt and contaminants from surfaces, even in small or hard-to-reach ares. This method is used to clean medical instruments, jewelry, electronic componenets, and precision mechanical parts.

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© Welding and Material Bonding :-

Ultrasonic welding is a manufacturing technique that uses high-frequency ultrasonic vibrations to bond meteriabls together. It is commonly used for welding plastics, as well as in the automotive and electronics industries. In this process, ultrasonic vibrations generate heat through friction at the point of contact causing the materials to melt and bond without requiring additional adhesives or soldering materials. This method is efficient, fast, and produces strong, durable joints making it ideal for mass production.

3) Environmental and Wildlife Applications :-

@ Sonar (Sound Navigation and Ranging) :-

Ultrasonic sound is widely used in sonar technology for underwater navigation, object detection, and mapping. Sonar works by emitting sound pulses underwater and measuring the time it take for the echoes

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to return after hitting an object. This is especially useful for submarines, under water exploration and naval operations. Addionally, Sonar helps in mapping the ocean floor and detecting shools of fish, making it an invaluable tool in marine biology and environmental studies.

(b) Animal Repellents:-

Ultrasonic sound waves are often used as pest and animal repellents. Many animal, such as rodents, birds, and insects, can hear ultrasonic sound frequencies that human cannot. Divices emitting ultra sonic waves are used to deter these animals from certain area without herming them. For example:- ultrasonic reppellers are used to keep rodents away from homes or to prevent birds from perching in unwanted area.

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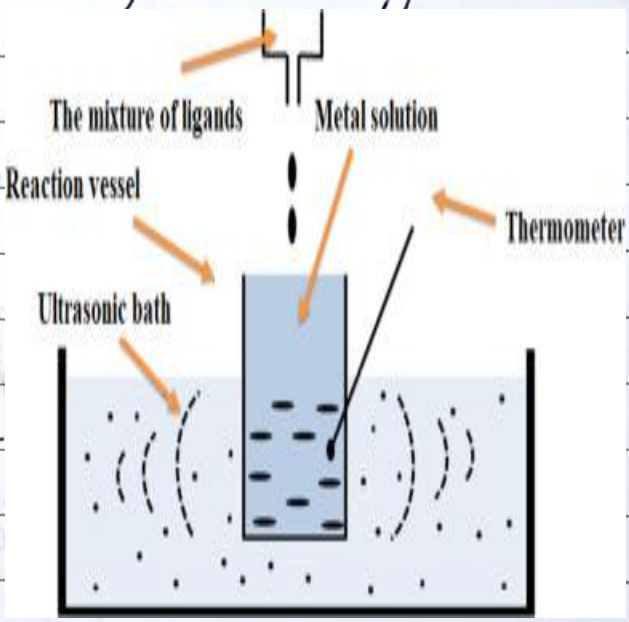
4) Scientific and Research Applications :-

(a) Sono chemistry :-

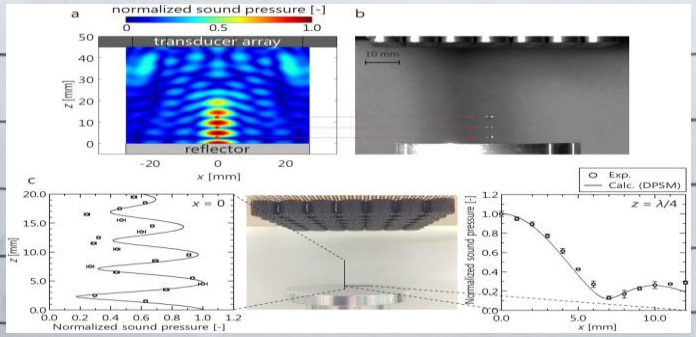
(b) Ultrasonic levitation :-

(a) In Sonochemistry, ultrasonic waves are used to accelerate chemical reactions. The energy from ultrasonic waves causes cavitation bubbles in a liquid medium, which collapse and generate intense localized heat and pressure. This can lead to faster reaction rates, improved yields, and more efficient processes. Sonochemistry has application in pharmaceutical synthesis, nanoparticle formation, and environmental clean up efforts.



(b) Ultrasonic levitation :-

Ultrasonic sound is also employed in acoustic levitation, a fascinating area of scientific research. Ultrasonic sound waves are used to create standing waves in a medium, which can exert sufficient pressure to lift and hold small objects in mid-air. This phenomenon is of great.



interest in fields such as material science and chemistry, where its allows for the manipulation of delicate substances without pysical contact, preventing contamination.

* Conclusion

Ultrasonic sound has a wide range of application across multiple fields, thanks to its unique ability to penetrate materials and interact with them in non-invasive ways. In medicine, it provides criticals diagnostic and therapeutic tools, while in industry, it plays a key role in meterial testing, cleaning, and manufacturing. Ultrasonic sound also affers innovative solutions in enviromental monitoring, wildlife management and scientific research, highlighting its versatility and continued importance in advaning technology and Science. As reach contineous the potential for new and improved ultrasonic applications will likely expand even further.

Reference: ① Engineering Physic → Hitendra K. Malik.
② Skillwallah.
③ Engineering Physic → B.K. PANDEY.