Phantom Making - Gelatin and Agarose

June 1st, 2021

Introduction

This document lists instructions for the fabrication of phantoms that vary in speed of sound and currently used for the Structural Imaging Project. The matrix materials are Gelatin and Agarose.

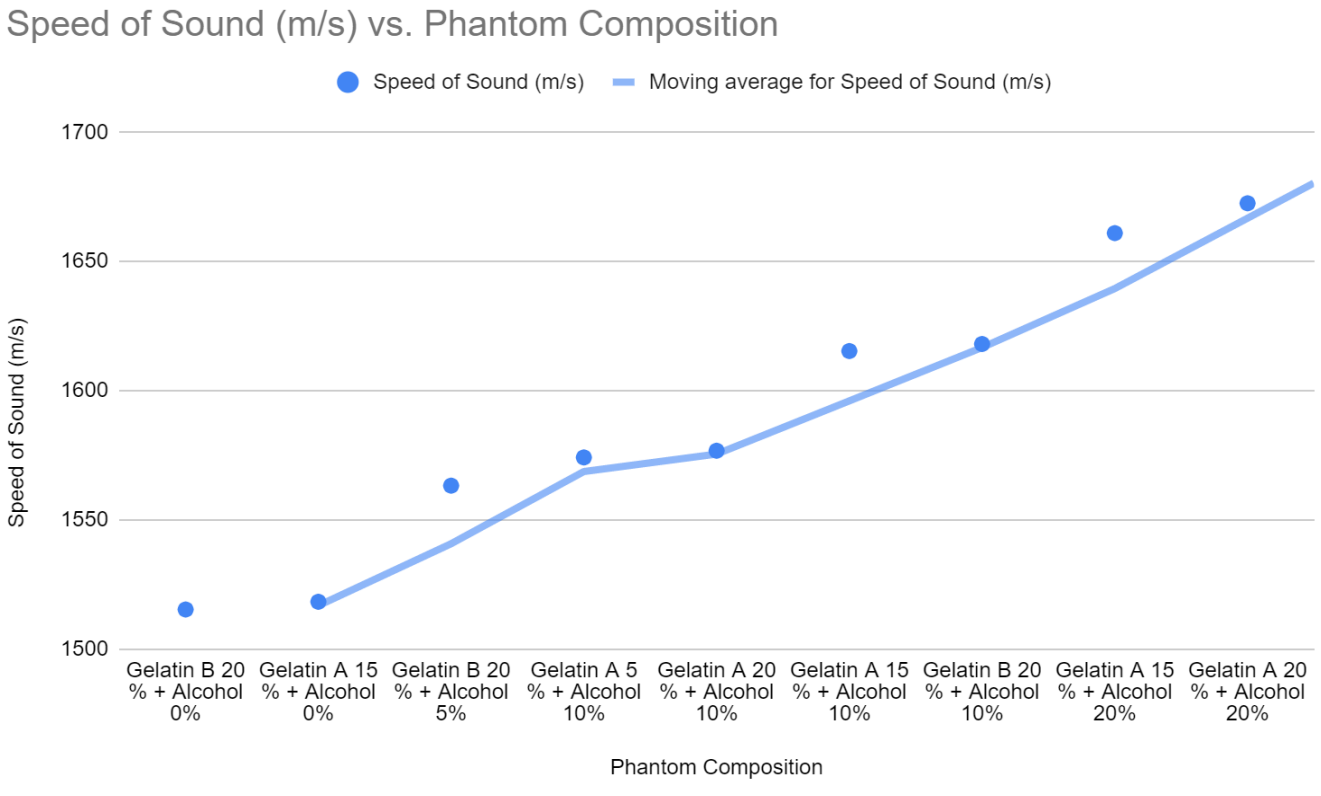
Gelatin

Gelatin is a common phantom-making material due to its easy accessibility in most supermarkets. Although most non-flavored gelatin brands can be used in order to create ultrasound phantoms, different types of gelatin could result in different speeds of sound for the same concentration in relation to water and alcohol. It is preferable to maintain a single type of powdered gelatin for phantom fabrication for consistency.

How to make phantoms

Ingredients: Powdered gelatin, tap water, and n-propyl alcohol

1. Decide on the percentage of gelatin in weight to the volume of liquid (water and n-propyl alcohol). Separate each of the ingredients.
2. Separate the volume of water to be used in two equal parts.
3. Mix the gelatin in powder to ½ of the water volume into a glass beaker and stir.
4. Microwave the water+gelatin mixture until bubbles are observed.
5. Mix the hot water+gelatin mixture with the room temperature remaining water and the alcohol.
6. Let it cool at room temperature or in the refrigerator.



Speed of Sound values

Phantom Composition	Speed of Sound (m/s)
Gelatin B 20 % + Alcohol 0%	1515.215201
Gelatin A 15 % + Alcohol 0%	1518.200841
Gelatin B 20 % + Alcohol 5%	1563.161706
Gelatin A 5 % + Alcohol 10%	1574.094419
Gelatin A 20 % + Alcohol 10%	1576.685682
Gelatin A 15 % + Alcohol 10%	1615.282845
Gelatin B 20 % + Alcohol 10%	1618.014739
Gelatin A 15 % + Alcohol 20%	1660.942447
Gelatin A 20 % + Alcohol 20%	1672.500078

Conservation

Preferrably gelatin should be kept in an airtight container. Wrapping the phantom in sarin wrap and placing inside a ziploc bag might reduce the risk of biological contamination/degradation, but the phantom should only last a few days. If placed in water, the phantom will swell due to osmosis and lose its acoustic properties previously defined.

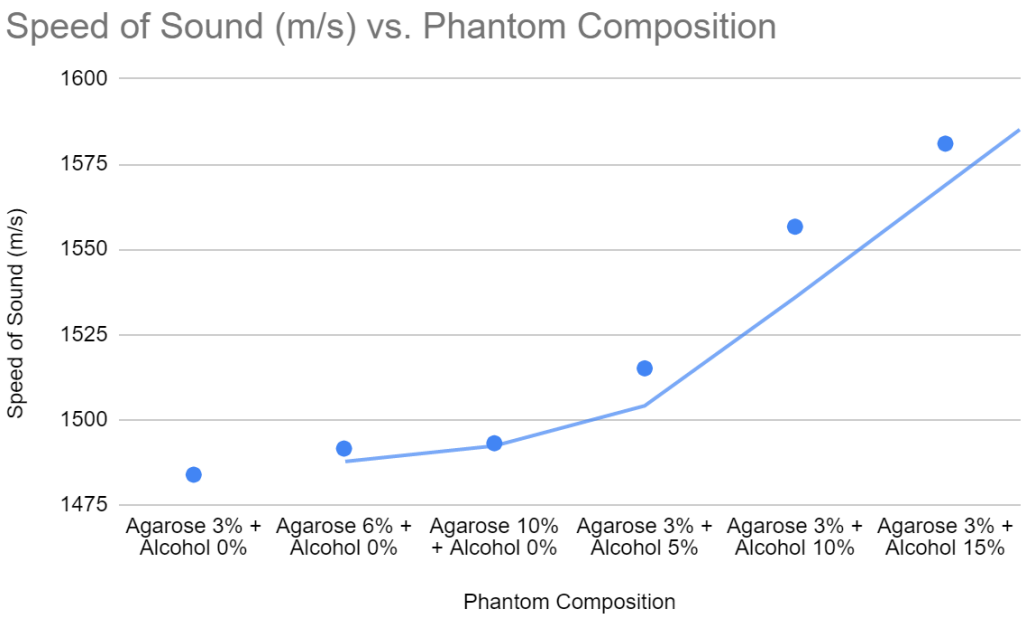
Agarose

How to make phantoms

Ingredients: Quick dissolving agarose, tap water, and n-propyl alcohol

1. Decide on the percentage of agarose in weight to the volume of liquid (water and n-propyl alcohol). Separate each of the ingredients.
2. Mix the agarose in powder to ½ of the water volume into a glass beaker and stir.
3. Cover the beaker with paper towels and tape down
4. Microwave the water+agarose mixture until bubbles are observed.
    a. Check the water level after microwaving, might need to correct for liquid evaporation
5. Let it cool at room temperature or in the refrigerator.

Speed of Sound values



Phantom Composition	Speed of Sound (m/s)
Agarose 3% + Alcohol 0%	1483.87
Agarose 6% + Alcohol 0%	1491.54
Agarose 10% + Alcohol 0%	1493.1
Agarose 3% + Alcohol 5%	1515.073401
Agarose 3% + Alcohol 10%	1556.638373
Agarose 3% + Alcohol 15%	1581.013244

Conservation

Agarose is preferable over gelatin due to its better outcome in preservation days after the phantoms is created. When placed in water, agarose can maintain its shape integrity for a few weeks.