hi i'm doing a physics project on centrifuges (how they work+applications of centrifuges) I understand what the centrifugal force is but why do the more dense particles get pushed to the end of the test tube? since the test tube is on its side gravity shouldn't have to do anythin with it. and why do the less dense particles end up being near the top of the tube. also could you help me with applications of centrifuges(medical, forensic, industrial, training humans)---perhaps some good links, because ive been having a really hard time, and wikipedia's page was disappointing appreciate any help thanks

Gravity has something to do with the action of a centrgifuge, but the reason for spinning the test tubes is to create an environment where the separating action on the particles is the same as it would be if you could significantly increases the force of gravity. So first you want to understand why the denser particles would go to the bottom and less dense particles to the top, and then understand how a centrifuge amplifies the effect.

A few forces are at work when an object is in a fluid. A couple of them come from gravity, and one comes from the viscosity of the fluid. Gravity attracts an object toward the center of the earth. This includes the molecules of a fluid, and causes an increase in the pressure of a fluid as you move closer to the earth's center. The result of gravity and the action of a fluid on a stationary object is a force that we often call the "apparent weight" of an object. It is the combination of gravity acting downward and the buoyant force acting upward. The force of gravity is proportional to the mass of an object, while (for a submerged object) the buoyant force is proportional to the volume of the object. Consequently, the net force (apparent weight) on a dense object is a greater fraction of its weight than that of a less dense object. Furthermore, when an object moves through a fluid there is a force that resists the motion of the object that depends on the viscosity of the fluid and on the area the object presents to the fluid. This accentuates the difference between the apparent weight and true weight of an object moving through a fluid. If you take a glass of water and pour in some dirt and shake it up, then let it settle, you find the more dense particles settling to the bottom of the glass more rapidly than the less dense particles because the net force per mass downward is greater for the denser particles. But it takes time for less dense particles to settle out, and for small particles whose density is not much greater than that of water, the time can be on the order of many hours to days. Some particles can remain "in suspension" indefinitely. If you could turn up the force of gravity, you could speed up the settling process, and even cause some particles that might otherwise remain in suspension to settle out. The cenrifuge is a device that has the same effect on the mixture of fluid and solids that would result from increasing gravity, with the added advantage of increasing it more at the bottom of the tube than at the top. Although to an "inertial observer" the spinning centrifuge does not produce a "real force" it does increase the pressure within the fluid, and it produces a motion of the particles in suspension that causes them to move toward the bottom of the test tube by actually moving the bottom of the test tube toward the particles. To an observer "in the test tube" the effect is the same as increasing the gravitational force by an amount that increases with the speed of rotation of the mixture and radius. This additional "apparent force" is called the centrifugal force and it is greater at the "bottom" of the tube than it is at the "top". This means that once the particles start to separate as they would under the influence of constant gravity, the separation of denser particles from less dense particles is accentuated. If you have time for your project, you might contact a centrifuge manufacturer and request information from them about how things work.

Last edited: Dec 17, 2006 Dec 17, 2006 #3 chroot Staff Emeritus Science Advisor Gold Member

Consider what happens when you drop styrofoam peanuts into a cup of water. Both the molecules of stryofoam and the molecules of water feel an equivalent force pulling them to the bottom of the cup. However, the stryofoam peanuts also experience a buoyancy force that pushes them up to the top of the glass. If you turn this cup upside down and spin it in a centrifuge, you are setting up the same situation, just on its side. Instead of gravity pulling things to the bottom of the test tube, you have the centrifugal "force" pushing things out to the end of the test tube. The same buoyancy force exists here, too, just turned on its side. Now, the less-dense styrofoam is pushed inwards (opposite the centrifugal force) by those buoyancy forces. - Warren Dec 17, 2006 #4 Astronuc Staff: Mentor

The 'centrifugal' force is proportional to mass. F = mv2/r or m ω 2 ω2r, so if m1 > m2, then F1 > F2. http://hyperphysics.phy-astr.gsu.edu/hbase/corf.html#cent and why do the less dense particles end up being near the top of the tube. The effect is essentially bouyancy. Just as in a gravitational field, the denser matter is 'pulled' in the direction of the force and the heavier matter displaces lighter matter. Last edited: Dec 17, 2006 Dec 17, 2006 #5 russ\_watters Staff: Mentor kewlkilla said: ↑ I understand what the centrifugal force is but why do the more dense particles get pushed to the end of the test tube? since the test tube is on its side gravity shouldn't have to do anythin with it. Simply put, the test tube is not on its side with respect to the 'new gravitational field'. and why do the less dense particles end up being near the top of the tube. A fluid is a fluid. If you drop a rock in water, it sinks because there is nothing holding it up. Dec 17, 2006 #6 kewlkilla Centrifuges on earth vs. centrifuges in space? I'm supposed to do a comparison but I'm not really sure where to start 1. there is no gravity in space, but that shouldn't really change much in regards to a centrifuge 2. is there Buoyancy in space? and could that possibly affect it? that's all i've got...can any1 help me please. Dec 17, 2006 #7 chroot Staff Emeritus Science Advisor Gold Member Your first point is correct. Your second point is not. Buoyancy forces work the same whether the centrifuge is on Earth or not. All that you need to have buoyancy forces is a force that acts on all the particles of your sample at once (like the centrifugal force) and a difference in the density of objects in your sample. - Warren Dec 17, 2006 #8 ZapperZ Staff Emeritus Science Advisor Education Advisor Insights Author 2016 Award I'm going to merge this with your already existing thread on a similar question. It also appears that this is a school work. Please note that we have a Homework/Coursework forum for this. The thread will be moved there. I would also suggest that you ask ONE question at a time, and make sure you understand it FIRST, before proceeding to another similar question. Chances are, your subsequent questions might be able to be answered if you had understood your first question. Zz. Dec 17, 2006 #9 kewlkilla chroot said: ↑ Your first point is correct. Your second point is not. Buoyancy forces work the same whether the centrifuge is on Earth or not. All that you need to have buoyancy forces is a force that acts on all the particles of your sample at once (like the centrifugal force) and a difference in the density of objects in your sample. - Warren Thank you, i see what you're saying...so is there no difference between centrifuges on earth vs. centrifuges in space? Dec 17, 2006 #10 ShawnD Science Advisor There is no difference between centrifuges on earth and centrifuges in space because gravity is in no way related to how a centrifuge works. A centrifuge forms layers based on density, and density is a property completely separate from gravity. If you've ever seen a centrifuge in real life, you may have noticed that it spins perpendicular to the force of gravity; this is done to assure that gravity does not interfere with the centripetal force applied by the centrifuge. Last edited: Dec 17, 2006 Know someone interested in this topic? Share this thread via Reddit, Google+, Twitter, or Facebook PF Insight Scavenger Hunt 2 Permanent Magnets Explained by Magnetic Surface Currents The Diffraction Limited Spot Size with Perfect Focusing Relativity Using the Bondi K-calculus The Joy of Processing Trick to Solving Integrals Involving Tangent and Secant Interview with Mathematician Fresh\_42 What Is The Most Important Thing That You Learned? Entanglement Entropy – Part 1: Quantum Mechanics Simple Geometry, Deep Math Interview with a Theoretical Physicist: Sabine Hossenfelder Similar Discussions: How do centrifuges work? Pulleys: How do they exactly work? (Replies: 2) How do hearing aids work? (Replies: 1) How do motors work? (Replies: 6) How do Mirages Work? (Replies: 4) How do Gullstrand's equations work? (Replies: 2) Forums > Science Education > Homework and Coursework Questions > Introductory Physics Homework > FORUMS VIDEOSINSIGHTS SEARCH LOG IN OR SIGN UP CONTACT US HELP ABOUT TOP Terms and RulesPrivacy Policy© 2001-2016 Physics Forums  
  
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