Rocket booster

SpaceX for the first time reused a rocket booster when it launched and landed a Falcon-9 rocket as part of a mission for the International Space Station.

Study details the physics of a café latte

New research by scientists at Princeton University has revealed the physics underlying the delicious layers of a café latte.

Quoting researcher Nan Xue, UPI reported, "The structure formation in a latte is surprising because it evolves from the chaotic, initial pouring and mixing of fluids into a very organized, distinct arrangement of layers."

Xue is a grad student working in the lab of Howard Stone, professor of mechanical and aerospace engineering at Princeton.

Though inspired by an everyday drink order, Xue's investigation yielded insights into the layering of fluids — insights that could have a variety of useful applications.

Stone said, "From a manufacturing perspective, a single pouring process is much simpler than the traditional sequential stacking of layers in a stratified product.

"In one application of this study, we are exploring the physics behind making a whole layered structure with one step, rather than one-by-one stacking of the layers."

Xue initially experimented with store-bought coffee and milk but struggled to maintain consistency as he attempted to recreate a latte's layers.

UPI

Scientists have discovered the physics that account for the layering of coffee and milk in a cafe latte.

To simplify the experimentation process, he used dyed water as stand-in for hot coffee and salty, denser water as a substitute for warm milk.

Xue and his research partners mixed racer particles into the two liquids and used light-emitting diodes and a camera to track the movement of fluids during the mixing and layering process.

The collected data — which scientists compared with models of intermixing liquids — revealed the physical principles underlying the phenomenon.

As revealed by their analysis, the most important mechanism is double-diffusive convection.

The mechanism describes the flow patterns as different density liquids mix and heat is diffused.

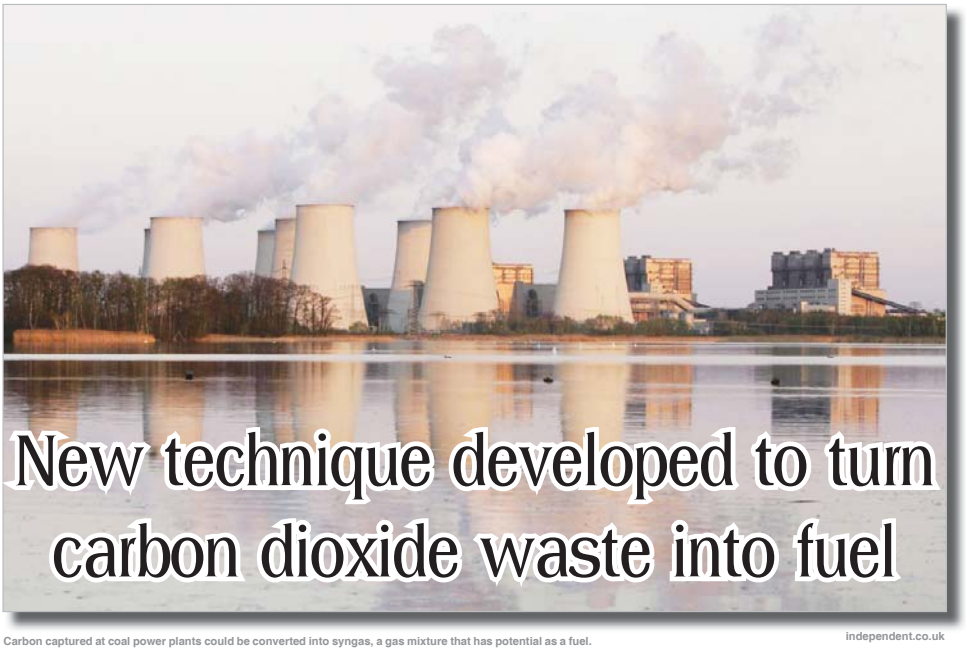
At first vertical flows occur, but as temperature and density differences begin to reach equilibrium, flows begin to move horizontally and layers develop.

The mechanism is dependent on the temperature and density difference of the liquids and —in the case of a café latte — the speed at which the milk is poured into the coffee.

If poured too slowly, the milk and coffee mix too evenly and distinct layers fail to form.

Researchers are now working on understanding how double-diffusive convection might work in other liquids and semi-solids.

That Xue was able to replicate the layering process of a café latte using water with different levels of salt suggests the findings — published in the journal Nature Communications — could help scientists better understand currents and upwelling in the ocean.



New technique developed to turn carbon dioxide waste into fuel

Carbon captured at coal power plants could be converted into syngas, a gas mixture that has potential as a fuel.

independent.co.uk

Scientists working for the US Department of Energy have found an efficient way to turn waste carbon dioxide into fuel.

Carbon dioxide is released by the burning of fossil fuels, and is a major contributor to global warming, independent.co.uk reported.

Carbon capture and storage is the process of collecting waste carbon dioxide from fossil fuel power plants and storing it in a way that prevents it from entering the atmosphere.

The process has been touted as a means of reducing fossil fuel's contribution to global warming.

However, the cost of carbon capture and storage has prevented the fossil fuel industry from widely implementing such measures.

The appeal of the new process is that it produces syngas, a mixture of hydrogen and carbon monoxide that can be used as a fuel — making the process more appealing to industry.

Dr Luis Diaz Aldana, a researcher at the Idaho National Laboratory who led the project, said, "It integrates two areas that have been on parallel tracks: Carbon capture and sequestration and carbon dioxide utilization.

"The problem with carbon capture and sequestration has been its economic feasibility. If you can get some extra value out of the carbon dioxide you are capturing, it's a different story."

Normally reusing the carbon from carbon dioxide is energy-intensive, as it requires high temperatures and pressures, but the process developed by Diaz Aldana and his colleagues, described in the journal Green Chemistry, does away with the need for them.

The researchers used 'switchable polarity solvents' — liquids that dissolve carbon dioxide at low temperatures and allowed the team to capture the carbon from it more efficiently.

Professor Stuart Haszeldine, a carbon capture and storage expert at the University of Edinburgh who was not involved in the study, said, "This is an interesting piece of science which has discovered a much more effective method of electrolyzing carbon dioxide in water."

Though the syngas produced from this process is itself a fuel that, when used, has the potential to contribute to global warming, Professor Haszeldine said this method could still have a role in reducing fossil fuel use.

He added, "This type of approach can recycle the carbon from fossil fuel for reuse as fuel, and so could reduce the need for oil companies to keep on extracting fossil oil or gas and adding to climate change caused by greenhouse gases."

However, he also noted the work by Diaz Aldana and his collaborators was a pilot study, and still had an 'immense pathway to travel' before it could be widely applied in industry.

Dr Hannah Chalmers, another University of Edinburgh researcher who was not involved in the study, pointed out the new technique should not be viewed as a replacement for traditional carbon capture and storage that prevents carbon dioxide pollution altogether.

She said, "If products containing carbon are produced, carbon dioxide could still be made again later and released to the atmosphere.

"This means that there may still be a need for 'conventional' carbon capture and storage to ensure that carbon dioxide is stored securely away from the atmosphere for the timescales that are necessary to reduce the risk of dangerous climate change."

Garlic and fluorine combination shows promise as drug therapy

There's a lot more to garlic than its distinctive odor and strong, pungent taste. For centuries, the allium root vegetable has been used as a natural medicine.

Athletes at the first Olympics in ancient Greece ate it to enhance their strength and stamina. During World War I and II, soldiers were given garlic to prevent gangrene, according to phys.org.

More recently, scientists have found that compounds in garlic serve as a natural antibiotic to prevent and fight various diseases and illnesses.

Garlic fluorination

In a new study, Eric Block, a distinguished professor of chemistry at the University at Albany, along with Shaker A. Mousa, vice provost for research at Albany College of Pharmacy and Health Sciences, and seven of their colleagues looked at whether adding the chemical element fluorine into natural garlic-derived compounds would enhance beneficial biological activity.

Fluorine is one of the most reactive elements in the periodic table and widely used in the pharmaceutical industry.

For example, several of the top 10 best-selling drugs contain fluorine atoms, including Pfizer's cholesterol-lowering agent Lipitor and Prevacid, a medication used to treat and prevent stomach and intestinal ulcers.

medicalnewstoday.com

The scientists hypothesized that garlic and fluorine could prove to be a powerful combination.

Block said, "Since its discovery, the antibiotic properties found in garlic compounds have been the subject of extensive research.

"Given the great importance of fluorine in medicinal chemistry and chemical biology, we were interested in observing the effect that fluorine substitution would have on the chemical reactivity and biological activity of garlic compounds. Such fluorinated analogs were presently unknown."

To test their hypothesis, the scientists modified several garlic compounds, replacing hydrogen atoms with fluorine atoms.

Once completed, they used 10-day-old chick embryo eggs to compare the effectiveness of the fluorine-modified compounds and unmodified compounds as anti-angiogenesis and antithrombotic agents.

Anti-angiogenesis agents are used to fight against cancer by blocking tumor growth, while antithrombotic agents help reduce the formation of blood clots.

Results showed the modified compounds were superior in biological activity and should be considered in the development of future drug therapies.

Block said, "Our results show evidence that new pharmaceuticals can involve modifying naturally-formed garlic compounds to enhance their beneficial biological activity.

"This paper represented a pilot study. Future work requires modifying the laboratory procedures to make the new compounds discovered more readily available, and at a lower cost, to facilitate more detailed laboratory, biological and, potentially, clinical study."

Magnetic fields explain periodic binge eating of starving white dwarfs

It turns out white dwarfs, long classified as 'non-magnetic', have magnetic fields.

In studying the consumption patterns of white dwarfs, astrophysicist Simone Scaringi discovered magnetic gates explain the starve-binge growth patterns of white dwarfs, UPI wrote.

Scaringi, a researcher at the University of Canterbury in New Zealand, said, "We have seen episodes of strong flares of accretion interrupted by periods with no evidence of accretion.

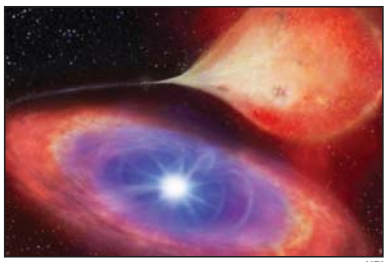
"This sporadic activity is best explained by the presence of a strong magnetic field comparable to that of 1,000 fridge magnets."

White dwarfs are what sun-like stars become after they've used up all their nuclear fuel. No longer able to generate fusion, the dead stars shrink to roughly the size of Earth — but still with the mass of the Sun.

White dwarfs grow by robbing material from other bodies. Usually, they accrete material from a companion star.

Years of studying white dwarf growth patterns showed the orbs grow very slowly. Most of the time they're starved for material. When they do accrete material, it happens all at once, in sudden bursts.

In studying patterns among white dwarf data collected by NASA's Keppler observatory, Scaringi found a white dwarf behaving as if it boasted a strong magnetic field.



UPI

An artistic rendering shows a white dwarf accreting material from its stellar companion.

In his latest paper, published in the journal Nature, Scaringi argues that magnetic fields best explain why white dwarfs accrete material all at once.

Scaringi said, "This magnetic field 'gates' the accretion, causing the matter to pile up until it has a gravitational attraction stronger than the magnetic forces holding it back, indicating for the first time that even 'non-magnetic, white dwarfs can have very strong magnetic fields."

The new findings don't distinguish white dwarfs from other stellar objects as much as showcase the universal patterns of 'magnetospheric accretion'.

Similar patterns of binge-eating are exhibited by black holes, neutron stars and young proto-stars.

Scaringi said, "Now we have further evidence that magnetic accretors like the one in our paper also behave in the same way, irrespective of their origin.

"Similar bursts have been observed in accreting neutron stars — which are much smaller and have magnetic fields much higher than our white dwarf — and in young stellar objects, which are on the other end, being much larger and owning much weaker magnetic fields."