

Company Profile

Liquids Research Limited, founded in 1990 by Professor K. O'Grady and Dr. S. W. Charles, is a leading



manufacturer of ferrofluids occupying modern facilities in the MENTEC Technology Centre, a science park in Bangor. The founders are internationally recognised as experts in the field of magnetic liquids, (ferrofluids, magneto-rheological fluids, etc.), leading many research projects

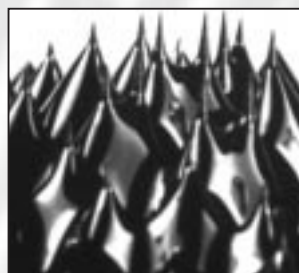
covering the fundamental aspects of these materials and other fields also based on fine magnetic particles.

They are continuously updated on the latest research and development and thus are an obvious choice for consultancy advice in these fields. They belong to a number of committees involved with magnetic liquids and are the authors of many original scientific papers.

Ferrofluids and other magnetic composite materials are produced in the company's well equipped laboratories augmented by access to the University's research facilities. In addition to the traditional ferrofluids based on hydrocarbon and diester technology we have available fluids based on silicon and perfluoropolyether materials.

The strong research and development base, which is unusual in such a small company, enables a fast response in the development of new specialist materials and products required to meet new technological demands.

Among its achievements the company has received three SMART awards for research and technology from the Department of Trade and Industry and has participated in a number of major projects partly funded by the Commission of the European Communities.

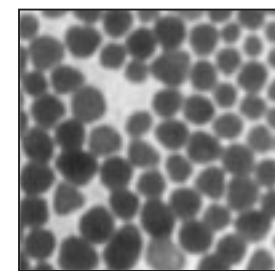


Liquids Research Limited is accredited with ISO9002 registration which along with our long term aim of continuous quality improvement ensures that our customers have available the best possible products and service.

Bangor is situated in an area of outstanding natural beauty and has good access by road and rail. Manchester International Airport is less than a 90 minute journey via the newly completed A55 trunk road which also connects to the UK motorway system.

Ferrofluids

Ferrofluids, or magnetic liquids, are stable colloidal suspensions of single domain particles of ferromagnetic or ferrimagnetic materials. They have existed for more than sixty years but the concentrated fluids that are used today first appeared in 1965. They consist of nanometre sized



magnetic particles held in suspension in a carrier liquid by a surface active layer. The carrier liquid is selected to meet the particular application and can be a hydrocarbon, ester, perfluoropolyether, water,

etc.. For example, we have ferrofluids suitable for ultra-high vacuum rotary sealing applications. Such fluids typically have oil vapour pressures of less than 10^{-10} mbar for hydrocarbon based sealing fluids and 10^{-9} mbar for pfpe based sealing fluids. We also have available a wide range of ferrofluids suitable for loudspeaker applications.

Liquids Research Limited can offer a wide range of ferrofluids in which the magnetic particles are one of a variety of ferrites or transition metals, such as iron and cobalt. The mean particle diameter (5 to 13 nm) can be tailored to meet the individual requirements of the customer as can the concentration of particles and the viscosity of the ferrofluids.

Ferrofluids for Biological Applications

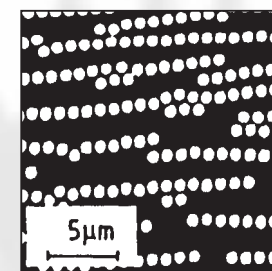
An increasingly important application in medicine is drug targeting using magnetic particles and microspheres. At Liquids Research Limited we have available nano sized particles based on ferrites which can be stabilised with polysaccharides such as dextran and polypeptides such as albumin. Additionally we can also produce polymerised microparticles of nanometric magnetic grains for cell labelling and magnetic bioseparation applications.

Magnetic Inks

We have developed magnetically readable inks suitable for ink jet printing. These inks are colloidally stable and consist of nanometer sized ferrite particles in water. We also have available magnetic inks composed of micron sized magnetic particles for screen printing applications and other impact printing technologies.

Magneto-rheological Fluids

Magneto-rheological fluids are stable suspensions of magnetically polarisable micron sized particles suspended in a low volatility carrier fluid, usually a synthetic hydrocarbon. Liquids Research Limited produce magneto-rheological fluids that are capable of giving high shear stresses at low applied magnetic fields. The unique nature of this class of magnetic fluid allows dramatic changes in rheology to occur within the bulk of the fluid on application of a relatively modest magnetic field. The material can change from being fluid to solid almost instantaneously, the rheology of the material reverting to its original state upon removal of the magnetic field.

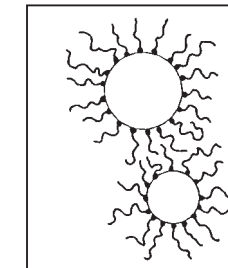


Magneto-rheological fluids are suitable for use in damping and other applications. These fluids are available from us for others to develop their own applications supported by our laboratory. We welcome the opportunity to participate with others in the development of applications using these unique fluids.

Philosophy

The philosophy of Liquids Research Limited is to supply specialist materials to industry with an interest in developing new applications for these exciting materials. An "in house" R & D capability is offered through which collaboration with other and usually much larger companies has been undertaken to develop new and innovative products based on ultra fine magnetic particles. Thus a range of products has been developed which are not available through other commercial sources.

Liquids Research Limited has a tradition of undertaking jointly exploited projects in novel magnetic materials. Work has been undertaken with



partners who have interests in organic chemistry, mechanical design and engineering and specialist needs in the field of magnetic circuit design. Liquids Research Limited is always open to invitations to participate in new projects.

Current applications for magnetic liquids include:

- Rotary shaft seals for vacuum systems.
- Rotary shaft seals for computer disk drives.
- Rotary shaft seals for chemicals, gases and radioactive materials.
- Bearing protection from abrasive environments.
- Loudspeaker performance enhancement.
- Magnetic separation of materials.
- Domain observation.
- Ink jet printing.
- Stepper motor dampers.
- Optical switches.
- Inclinometers.
- Cell labelling.
- Bioseparation

