Students aim to make new flame retardant for polystyrene—using genetically modified bacteria

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Leicester students are aiming to make polystyrene more fire resistant using genetically modified bacteria – creating a new, safer fire retardant.

University of Leicester undergraduates have formed a team to enter this year's International Genetically Engineered Machine competition (iGEM), following on from last year's successful entry.

The team hopes to make use of DNA's recently discovered application as a flame retardant to make expanded polystyrene (EPS) less flammable.

In order to produce large amounts of DNA at low costs, the students hope to genetically engineer bacteria to produce much more DNA in their cells than usual.

The DNA-rich bacteria could then be added to the polystyrene to make it less susceptible to burning.

Expanded PolyStyrene (EPS) – which is frequently used for insulation in buildings - is highly flammable and Hexabromocyclododecane (HBCD) is often added as a flame retardant in construction applications.

However, the European Union organisation REACH has listed HBCD as a "persistent bio-cumulative toxin" meaning that it can accumulate in the environment and alter biological processes, such as hormone levels in

fish.

REACH is phasing out HBCD by 2015, so developing an alternative flame retardant would be very good for the environment and the EPS industry.

There are 216 teams from Universities around the world competing in this year's iGEM competition – which challenges geneticists to synthesise novel organisms using a set of standard DNA parts.

In 2012, University of Leicester students entered the competition for the first time, with the aim of engineering bacteria to degrade polystyrene waste more effectively.

The team presented the results of their summer research project to the iGEM European Jamboree in Amsterdam, and drew praise from the judges – particularly for the "citizen science" public engagement element of the project.

A new team of University of Leicester undergraduates has entered the event this year, after the University's Vice-Chancellor Professor Sir Robert Burgess generously donated £1900 from the Vice Chancellor's Development fund to cover the cost of the entry fee.

The students will work in the laboratories of the Departments of Genetics and Chemistry over the summer vacation to develop a project for the 2013 European Jamboree – held this year in Lyon, France.

As well as reducing polystyrene flammability, the team hopes to develop a way of recycling polystyrene waste for use in 3-D printing, using DNA technology.

They also plan to continue developing genetically modified bacteria to

degrade polystyrene waste more effectively – and hope to repeat last year's citizen science experiment through outreach with local schools.

Team Instructor, Dr Richard Badge, a Lecturer in Bioinformatics in the University's Department of Genetics, said: "Polystyrene is very flammable, but one of its biggest uses is in insulating building. So, while expanded polystyrene is a fantastic insulator, it needs to be made less flammable."

"HBCD is the main chemical that has been used to make polystyrene fire retardant, but the European organisation REACH is phasing it out, so industry is going to be really interested in developing new fire retardants."

"Bacteria are not particularly DNA rich, so we want to engineer the bacteria to contain more DNA. To do this, we are going to use bacteriophages – a virus which infects and replicates inside bacteria. The idea is to engineer bacteria that will produce lots of DNA once we give them the right signal."

"The iGEM competition is a great opportunity for students to take part in. The sky is the limit in terms of what you can do with the DNA parts – it really is just down to the student's imaginations."

BSc Medical Genetics student Quezia Toe, 27, said: "iGEM is a project run by students, so you get a good idea of how you conduct research in the real world. I want to do a PhD after I graduate, and our iGEM project offers an opportunity that is very similar.

"The project is really exciting and interesting – especially for a geneticist. Some of the chemicals used as flame retardants are really non-environmentally friendly – so using DNA is a great idea."

UK-based firm Jablite, who manufacture fire-retardant polystyrene for the construction industry, and sister company Styropack specialising in polystyrene packaging for food and medicine, are supporting the team's project with materials and invaluable technical expertise.

Provided by University of Leicester