

# Polymer Materials – Development of Polymers for the Application in Harsh Environments

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<b>Aims of the activity/of the project</b>	The aim of this transfer-activity is to apply polymers to harsh environments (such as high temperatures or pressure) for the production of oil and gas.
<b>Persons responsible for the project</b>	<p>Prof. Dr. Alexander Bismarck (University of Vienna, Faculty of Chemistry, Head of the Department of Materials Chemistry) and his research group Polymer and Composites Engineering (PaCE)</p> <p>The PaCE group is a dynamic research team, founded in 2003 by Alexander Bismarck. PaCE is a multi-disciplinary team with expertise in the manufacturing and analysis of high performance composites, porous materials and hydrogels. Focus and application areas include the development of renewable green materials, biomaterials for applications in tissue engineering, composite super-capacitors and poly (HIPES).</p>
<b>Cooperation partners</b>	Industry cooperation

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## Project Description

The PaCE group developed a polymer, which allows more effective oil production. Further development of technologies and materials (such as polymers), which allow to produce as much oil as possible from one well, is decisive given the diminishing primary oil reserves, thereby increasing prizes and the environmental pollution due to oil production. For this purpose, rock formations with low permeability have to be made accessible. To access oil reserves within such formations, a pressure-pumping technology is being used – so-called Hydraulic Fracturing or Fracking. For Fracking, a mixture of water, chemicals and sand (hydraulic fluid) is being injected into a wellbore to create cracks in the deep-rock formations. The aim is to increase the permeability of the rock formations so that natural gas or oil will flow more freely and can be more easily extracted. So-called proppants (typically sand, treated sand or man-made ceramic materials) are being used to keep an induced hydraulic fracture open, during or following a fracturing treatment. To increase the viscosity of hydraulic fluid, polymers are being used. An increased viscosity is required for transporting proppants. In addition, polymers are used to decrease the friction between fluid and pipe, which allows more effective oil and gas production. At this, polymers with high molecular weight were proven to be particularly effective.

However, especially in rock formations with low permeability, deposition of polymers on rocks can block the pores in a rock and thus impede the production. Therefore, the application of polymers requires a clean-up treatment for the degradation of polymers, with the primary use of oxidizing agents. Frequently, this does not yield the desired results, which is why there is a need for water-soluble polymers with a high molecular weight that disintegrate into easily removable parts with a smaller molecular weight after use.

The polymer developed by the PaCE group (a polyacrylamide) has a high molecular weight and disintegrates at a specific temperature ‘by itself’ into parts with a lower molecular weight – thus, it is thermolytically degradable.

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## Results/Impact

Given the environmental pollution and for preserving the oil's purity it is the aim to use as little chemicals as possible for fracking. Since the developed polymer is thermolytically degradable, the additional use of oxidizing agents is unnecessary. This leads to a decreased time required for production, which in turn decreases the production costs.

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## Quality assurance/achievement of objectives

The PaCE group's research focuses the development of concrete applications. If the developed material – in this case thermolytically degradable polyacrylamide with a high molecular weight – can be successfully applied in practice, the objective is achieved. However, the development of new materials often also generates (potential) new application possibilities and research questions, respectively. The (further) development of polymer materials is a continuous research focus of the PaCE group.

Continued availability of oil necessitates the further development of methods and materials which can be applied in harsh environments (such as conditions 10 miles underground or 10.000 miles under water).

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## Webpage/ Publications

About PaCE: <https://mc.univie.ac.at/about-pace/>

Kot, E., Saini, R., Norman, L. R., & Bismarck, A. (2012). Novel drag-reducing agents for fracturing treatments based on polyacrylamide containing weak labile links in the polymer backbone. *SPE Journal*, 17(03), 924-930.