

Belgijski studenti na stručnoj ekskurziji u Hrvatskoj

Belgioan students on the excursion in Croatia

Bolonjski je proces obnovio jednu izvrsnu praksu. Mladi ljudi, pa i studenti trebaju upoznati život i rad u drugim sredinama. Međutim rijedak je slučaj da primjerice belgijski studenti izaberu za stručnu ekskurziju Hrvatsku. Kako su tijekom jednodnevne ekskurzije posjetili dvije tvornice i jednu znanstveno-nastavnu ustanovu povezanu s polimerstvom, Uredništvo Polimera je odlučilo njihove dojmove objaviti na stranicama časopisa.

The Gramme Institute

The *Gramme Institute* which recently celebrated its 100th anniversary was founded in 1906 by a Jesuit father. It is one of the 11 institutions which grant the industrial engineer diploma in the French-speaking community of Belgium. Its reputation is based on a challenging level of studies combined with high quality educational mentoring.

The last recent revision of the studies (Bologna) has allowed the graduated students from 2009 on to have the master degree in industrial engineering sciences.

The industrial engineering studies are an audacious mix of engineering sciences (mathematics, physics, chemistry ...), applied sciences (mechanics, electricity, thermodynamics...), technical courses (informatics, design and graphic techniques, technology...) and general courses (English, economics, philosophy...).

A polyvalent and rational industrial engineer was born out of this prodigious cocktail, able to solve several problems in the industry in which he doesn't take long to bring in his additional value.

But this polyvalence is also for the *Gramme* engineer an essential asset which allows him, if needed, to redirect his career in another field of the industry.

During the last five months of his studies, the student is immersed into the day-to-day life of a company which he has chosen according to the final orientation of his curriculum. In this company situated in Belgium or abroad, as an Erasmus student, and sometimes even in collaboration with a non-governmental organization (NGO), the future engineer can then refresh and revitalize the hundred-year-old motto of the *Gramme Institute* - *knowledge to serve*.

The Field Trip Abroad

During their training at the *Gramme Institute*, MA1 students have to organize a field trip abroad. They have to choose a destination, organize the logistics and a lot of activities on the spot. Those activities include technical, cultural and social visits, in order to discover the wealth of the country.

The FTA is a cross-disciplinary project involving teachers from the *Human Sciences Department* as well as teachers from different scientific departments.

The students have to write a report which is presented in English in front of a jury.

Why Croatia?

There were many reasons to choose this destination. One of them is that none of us had ever visited this country. Another reason for this choice is the culture which is quite different from Belgium. Croatia is an emergent industrial country which meant an opportunity for us to visit traditional

manufactures. Croatia is also known for its marvelous beaches on one side and its mountains on the other. We decided to travel inside Croatia and to visit two main cities of the country: Zagreb and Split.

We chose Zagreb, situated in the northwest of Croatia, because it is the largest city and the capital. Therefore, the economic situation is well developed in this part of the country. The fact that there is a concentration of industries and scientific institutions shows the leading economic position of Zagreb in Croatia.

In opposition to Zagreb, Split is situated on the seaside. This city is less diversified in industrial sectors. The most important sector is the naval construction and we also visited the *Brodotrogir Shipyard*, which is a naval construction site. Split also seemed to be more interesting for the cultural visits and looked more pleasant, and that is why we tried to find other companies there.

Cultural visits

During our trip, we had to plan at least three cultural visits, we chose to visit: the Zagreb city museum, the Zagreb old town, the historical center of Split and the *Plitvice Lakes National Park*.

The museum shows the history of Zagreb and therefore the life of the Croats. The starting period of the museum is around Stone Age to finish in the 1990s. During the visit you evolve through different ages in a chronological order. The rooms are full of various objects connected with different periods. The museum was not exactly what we expected to see (for example, there is a similar museum in Berlin called *The Story of Berlin* but this one is really better). Indeed, everything was not translated in English and the panels of explanations in English were not attractive enough to catch the attention of people. We also expected that the museum would answer many of our questions about the conflict which happened between 1991 and 1995 but this was not the case.

During the visit of the center of Split, we started the tour by walking around the ramparts under marvelous sun. It is the best way to discover the huge structure and see the dimension of the palace. Inside the palace, we found many of Split's historical and cultural buildings. We saw the St. Dominicus Cathedral, the Peristyle, the temple of Jupiter, the Palatic Palace and many other interesting monuments.

The *Plitvice Lakes National Park* is located along the highway between Zagreb and Split. This National park established in 1949 covers 296.85 km², and it was entered in the *UNESCO* World Heritage List in 1979. Its uniqueness is that there are sixteen staircase lakes, each feeding the next by waterfalls, in a landscape of forested mountains. The views are simply beautiful.

Technical visits

We had to find five technical visits and we tried to target various sectors of activities in order to gain as much knowledge as we could. We looked for a maximum of companies in the two cities: Split and Zagreb.

Those two cities are in total opposition concerning their situation as well as their economical poles. Indeed, Split is situated on the coast and has an economy developed around this advantage, we can find there traditional economic activities such as fishing, but also industrial ones such as shipbuilding. On the other hand, Zagreb presented the opportunity for us to visit a more industrialized city with much more conventional activities.

We received a warm welcome from the companies. Although they were not acting in the high technology production, but more in traditional and

mass production, the companies we visited were very interesting for most of them. Most of the companies were proud to give us a tour of their company, some of them even asked us if we would be interested in having partnership with their company. We could also notice real interest from them to know more about the Belgian industries to compare with theirs. Those meetings were the opportunity both for us and for them to get to know better each other's standards of living. Here are the companies we visited:

Brodotrogir (near Split) is specialized in the construction of ships and floating objects. Its production program includes oil and chemical tankers, floating docks, passenger ships, supply ships, tugs, rescue boats, etc. We visited the shipbuilding and the repairing ship department. The different sites and the technical masteries are impressive.

The *University of Zagreb* was founded in 1669 and is the oldest and biggest *University* in South-Eastern Europe. We visited more specifically the *Faculty of Mechanical Engineering and Naval Architecture*. A few students showed us different departments of the university. We can quote for example: robotics, welding, technical execution, the study of marine

corrosion and metrology department. Those visits illustrated very well the courses given at the *Gramme Institute*.

DIOKI is a company specialized in the production of petrochemical and plastic materials (polyethylene, polystyrene and other goods). The production site is situated in Zagreb.

Elektrokontakt is a manufacturer of electro-technical products that was created 80 years ago. The production site is situated in Zagreb. The products are diversified: electro-installation materials and components for household appliances.

DOK-ING has been established in Zagreb for 20 years. It produces robots and special-purpose equipment. It is also the international leader in the production of machines for landmine clearance.

We spent in Croatia a very stimulative and inspiring week.

Acknowledgments: *a warm thanks to Prof. I. Čatić who found for us a lot of technical visits and many thanks to Mr O. Praz for having participated in our trip as a member of the teaching staff. We'll never forget the different companies which welcomed us in a very warm environment. And we would also like to thank the professors who helped us in organizing this trip.*

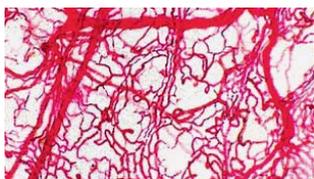
Samooporavljajući materijali

Privedio: Igor ČATIĆ

Potrebu tehničara da rješenja traže u prirodnoj tehnici, časopis *Polimeri* promiče još od 1982. Evo jednoga novog primjera.

Razvoj samooporavljajućih materijala temelji se na razvoju novih rješenja inspiriranih biološkim sustavima.

Istraživači sa *Sveučilišta Illinois*, SAD, našli su način kako ubrizgati zacjeljujuću kapljevину oko materijala slično cirkulaciji životinjskog krvotoka (slika 1). Rezultati su objavljeni u *Journal of the Royal Society Interface*.



SLIKA 1 – Ideja o samooporavljajućem materijalu – životinjski krvotok

Materijali koji mogu sami oporaviti nastale pukotine ponajprije su namijenjeni primjeni u graditeljstvu.

Takvi materijali istraživani su gotovo desetljeće, s namjerom da se smanji rizik i troškovi štete zbog lomova različitih materijala.

Pri kreiranju takvih materijala primijenjeni su različiti pristupi, ovisno o materijalu koji je trebalo popraviti: metalima, plastici ili kompozitima ojačanim ugljikovim vlaknima.

Postupci su uključivali stvaranje materijala s mikrokapsulama koje sadržavaju oporavljajuće sredstvo i koje se otvaraju kada je materijal oštećen ispuštajući kapljevину koja očvršćuje i ispunjava pukotinu.

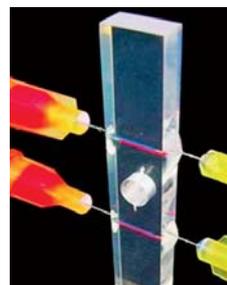
Iako djelotvoran, ovaj je postupak ograničen malom količinom sredstva koje sadržava mikrokapsula, jer ona mora biti dovoljno mala da ne oslabi materijal.

Novi razvoj postupka samooporavljivanja razvili su prof. Nancy Sottos i njezina istraživačka skupina na *Sveučilištu Illinois (University of Illinois Urbana-Champaign)*, a sastoji se od impregnacije plastike s finom

mrežom kanala, od kojih je svaki promjera manjeg od mikrometra, koji se pune kapljevitom smolom.

Takva *mikrovaskularna* mreža omogućuje protok sredstva za oporavljanje materijala poput krvotoka, opskrbljujući sva područja tom kapljevinom spremnom za otpuštanje kada se pojavi pukotina. No još postoje ograničenja jer se oporavak temelji na sporom procesu i difuziji oporavljajućeg sredstva u pukotinu.

Istraživači su zato naučili još jednu lekciju od prirode da poboljšaju proces. *U biološkim sustavima kapljevine se upumpavaju i teku*, rekla je N. Sottos, pa su smislili način kako aktivno pumpati kapljevину u mikrovaskularnu mrežu. Štrcaljke na vanjskoj strani materijala tlače oporavljajuću kapljevину, koja odmah nakon pojave pukotine pod tlakom ulazi u nju (slika 1).



SLIKA 2 □ Ulazak oporavljajuće kapljevine u materijal

U eksperimentu koji je provela N. Sottos sa suradnicima stvorena su dva paralelna kanala u plastičnome materijalu koja su napunjena kapljevitom smolom i umreživalom koje omogućuje očvršćenje smole. Čim nastane pukotina, pucaju kanali i obje se kapljevine (smola i umreživalo) pumpaju u oštećeno područje. Istraživači su eksperimentirali ciklusima pumpanja kapljevine tako da prvo uđe smola u pukotinu, a tek onda umreživalo, i to u ponavljanim ciklusima. To se pokazalo kao najučinkovitiji način popunjavanja većih pukotina koji osigurava najbolje širenje oporavljajućeg sredstva u pukotini.

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