doi:10.2533/chimia.2017.605 Chimia 71 (2017) 605–606 

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# Producing Renewable Energies Swiss Innovation at EXPO 2017 in Astana

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**Keywords**: Expo · Future energy · International · Microbial Fuel Cell · Workshop

*It was a daring venture when Professor **Fabian Fischer**, lecturer in chemistry and biotechnology at HES-SO Valais/Wallis, organized a Microbial Fuel Cell Workshop at EXPO 2017 in Astana, the capital of Kazakhstan. This first world exhibition to be held in Central Asia (from 10 June to 1 September) is dedicated to 'Future Energy' and showcased Switzerland as an innovative country for energy efficiency, renewable energies and global water management.*

When Fabian Fischer touched down on Kazakh soil at 4 o'clock on a summer morning, the city on the banks of the Ishim River was still asleep. While Almaty is still the country's commercial and cultural heart with its 1.7 million inhabitants, Astana is a 25-year-old planned town with striking modern architecture set in a flat, semi-arid steppe region with only 18,000 residents, of whom 66% are Kazakhs and 21% Russians.

## A lot done, a lot more to do

It is not a coincidence that EXPO 2017 in Astana is dedicated to future energy resources. Kazakhstan depends heavily on oil: since the turn of the millennium, its gross domestic product has grown more strongly than at any time in the past due to earnings from crude oil and gas extraction. With output at 81.8 million tons per year (2013), Kazakhstan is one of the 20 leading oil producers. The country is also the world's largest uranium producer, is among the 20 largest gold producing countries and also has a large copper mining industry with an output of 493,000 tons p.a. (2013). In recent years, coal extraction has been the subject of targeted development. The output of 120 million tons per year is destined mainly for domestic use. Electricity is primarily generated by fossil fuels (89%, compared with only 1% by renewable energies). Therefore Kazakhstan has a justified interest in opening up new sources of energy.

"Corresponding competencies have to be established at universities, like the L. N. Gumilyov Eurasian National University in Astana, one of the leading universities in Kazakhstan", says Prof. Fabian Fischer, lecturer at HES-SO Valais Wallis in Sion. His special areas of research are microbial fuel cells (MFC) for power production from biomass, a subject of growing importance at an international level. The production of methane, recovery of $CO_2$ and other useful applications are also envisioned for MFCs. Moreover, the biofuel cell concept has been applied to microbial activity sensing, which makes it possible to assay the metabolic activity of microbes.

## The 'Heat Power Engineers' roll up their sleeves

On July 28, Fabian Fischer opened the doors at the Swiss Pavilion. Teaching staff and students of the L. N. Gumilyov Eurasian National University (ENU) took part in a workshop on microbial fuel cells, despite it being held during the vacation period. The expert first gave a brief introduction to MFC – a future source of energy that converts wastewater, food waste and other organic substances into bioelectricity and generates purified water at the same time. He spoke about laboratory work done at HES-SO in Sion, where stacked microbial fuel cells are currently under investigation. A 12-litre MFC was recently constructed. This reactor has been operated under various parameters to yield information on how to prevent and resolve voltage reversals, on charging lithium batteries, and on its potential for simultaneously purifying wastewater (see *Bioresource Technology* **2017**, *238*, 519–527). Work is also being conducted with real wastewater on a pilot scale in collaboration with several wastewater treatment plants in Switzerland.

View from the central globe towards buildings hosting countries pavilions. Photo Fabian Fischer.

He then handed out a MFC kit for small-scale experiments so that the participants could explore their knowledge and demonstrate to themselves the basic functioning of a MFC. At the end, each participant left the event as the happy owner of a workshop certificate and a small microbial fuel cell. "The workshop was supported by Swissnex Lab", says Fabian Fischer. "It is targeting thematic immersion and networking to facilitate bilateral cooperation and academic exchange between Switzerland and Kazakhstan. The event also allows visitors to conduct experiments and slip into the shoes of an energy scientist." Further exchanges with Swiss researchers include a seminar with the University of Applied Sciences of Lucerne on 'An Entire $CO_2$ Neutral Region' as well as a joint Kazakh-Swiss seminar with the University of Zurich on the issue of 'Future livelihoods in Kazakhstan: Current developments, problems and perspectives'.

The participants during the Microbial fuel cell workshop exploring this future source of energy transforming waste water, food waste and other organic material into bioelectricity. Photo Présence Suisse est l'unité du Département fédéral des affaires étrangères.

Small scale microbial fuel cell with multimeter, assembled by the participants in the workshop of Professor Fabian Fischer and used in experimental work. Photo Marc Sugnaux, HES-SO Valais.

## The first step towards effective cooperation

"The in-depth training of specialists in this field is of great importance for Kazakhstan, as many technical challenges need to be resolved by engineers", Fabian Fischer recalls. "They need wastewater treatment, a more efficient use of water in industry, waste management, recovery of energy to produce less heat, heating technology and a better energy supply." In fact, he has the – not entirely unselfish – ambition of working with colleagues from Astana on specific microbial fuel cells in extreme weather conditions: the new city lies at the heart of Kazakhstan's desert region, where night-time temperatures can fall to 40 degrees below zero – perfect conditions for his test series! He has a very positive outlook on the future: "Wherever you go, people in Astana are open and honest, and very hospitable!" And, as Fabian Fischer says with a smile: "You'd better not trust the buses here, but the indigenous drivers are really nice: Stand at the side of the road and extend your index and middle fingers towards the street. A car will stop immediately and the driver will take you wherever you wish – good value for money!" Astana is also a place where different cultures and ways of life meet. "I'd never been to Kazakhstan before, so the encounters with different people and their personal experiences was greatly enriching", is Fabian Fischer's positive verdict. In his spare time he met people from all over the world while visiting other pavilions.

The Chinese team boasted that at their Hefei Institute of Physical Science researchers could generate hydrogen plasma at a temperature of about 50 million degrees Celsius, and that they could maintain the reaction for an incredible 102 seconds.

The Russian crew was pleased that their 'Arctica' is the largest and most powerful icebreaker and will open up now sources of gas.

Representatives of Malaysia enthused about the gasification of biomass and especially the pyrolysis of oil palm shells.

But when Fabian Fischer, at the OPEC booth, wanted to speak about 'peak oil' – the point at which global maximum oil production will be attained – he also learned that the energy crisis we are talking about today is subject to a wide range of views. The gathering in Astana highlighted the diversity of future energies and provided a good platform for debate.

The next World Future Energy Summit will take place in Abu Dhabi in January 2018 – let's see what it brings!

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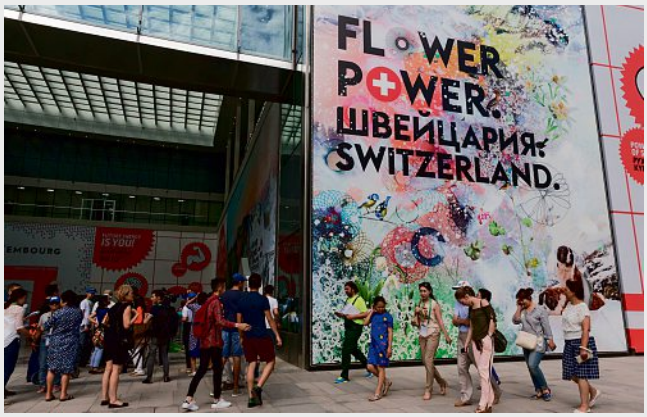
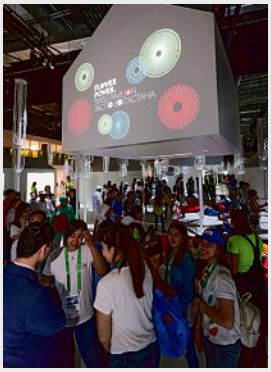
### EXPO 2017 in Astana

The Swiss pavilion at the EXPO 2017 in Astana was organized by the Federal Department of Foreign Affairs FDFA with a budget for construction and operation of the pavilion of CHF 4.2 million. The exhibition includes an interactive Swiss 'Flower Power' pavilion with examples of Swiss innovation in energy efficiency and renewable energies. There are four themes: solar power, a 'potato power house', water management, and Swiss innovation. In the solar power house, visitors can experience the Swiss pioneering spirit in the field of energy and building technology. An example of a structure that is largely energy self-sufficient is the Monte Rosa Hut on the Gorner Glacier. It illustrates the sun's potential as an energy source. In a second house, a rösti cooking demonstration shows how the daily consumption of energy affects our environment and what we can do in our daily lives to use energy more efficiently. The third house, designed in collaboration with the Swiss Agency for Development and Cooperation (SDC), focuses on water as a natural resource and source of energy. And finally the fourth house demonstrates Swiss innovation through SolarStratos, a solar aircraft flown by the Swiss eco-adventurer Raphaël Domjan to the stratosphere – the edge of space and at the boundary of what is technically feasible.

*http://houseofswitzerland.org/events/expo-astana-2017*




In front of the Swiss Pavilion attracting visitors with the motto flower power. Photo Présence Suisse est l'unité du Département fédéral des affaires étrangères.



Inside the Swiss Pavilion at Astana EXPO 2017. Photo Présence Suisse est l'unité du Département fédéral des affaires étrangères.