



## 80 years of Biodiesel

Georges Chavanne: Belgium's renowned chemist as inventor of Europe's most widespread biofuel

Dr. Thierry Randoux

President of the *Société Royale de Chimie*  
Brussels June 8, 2017





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- Introduction to the Société Royale de Chimie
  - Georges Chavanne: 1875-1941
  - Some words about Certech: Chemical contract research organisation



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- 1887: creation of the *Association Belge des Chimistes*.
  - 1904: the association becomes the *Société Chimique de Belgique (SCB)*.
  - 1930: creation of the *Bulletin de la Société Chimique de Belgique*.
  - 1939: split in 2: *Vlaamse Chemische Vereniging (VCV)* and *Société Chimique de Belgique (SCB)*.
  - 1987: celebration of the centenary of the association. SCB becomes *Société Royale de Chimie (SRC)* and VCV becomes *Koninklijke Vlaamse Chemische Vereniging (KVCV)*.



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- A non-profit association bringing together chemists from the Wallonia-Brussels federation.
  - A meeting place open to researchers, teachers, industry from the chemical sector, but also, in a broader way, to all of those for whom chemistry is a center of interest.



- Encourage exchanges with chemists in the European union
- Special focus on young chemists to help them meet, grow and integrate into the scientific and industrial community of chemistry
- Promoting the image of chemistry, highlighting its contribution to science, our well-being and our economy (2nd industrial sector, 26.400 direct jobs and 40.000 indirect jobs in Wallonia, turnover of 13 billion € 1.5 billion invested in R & D).
- Chimie Nouvelle (Quadrimestry Review publishing articles on current topics and recent developments in both academic and industrial research, on the activities of sections and divisions, research organizations, national and international symposia)
- Bibliographical alerts from Belgian universities



# Industry Members

**ExxonMobil**  
*Chemical*

**Lonza**



**TOTAL**

**DOW CORNING**



**essenscia**

**allnex**  
The Coating Resins Company



**SOLVAY**

asking more from chemistry®

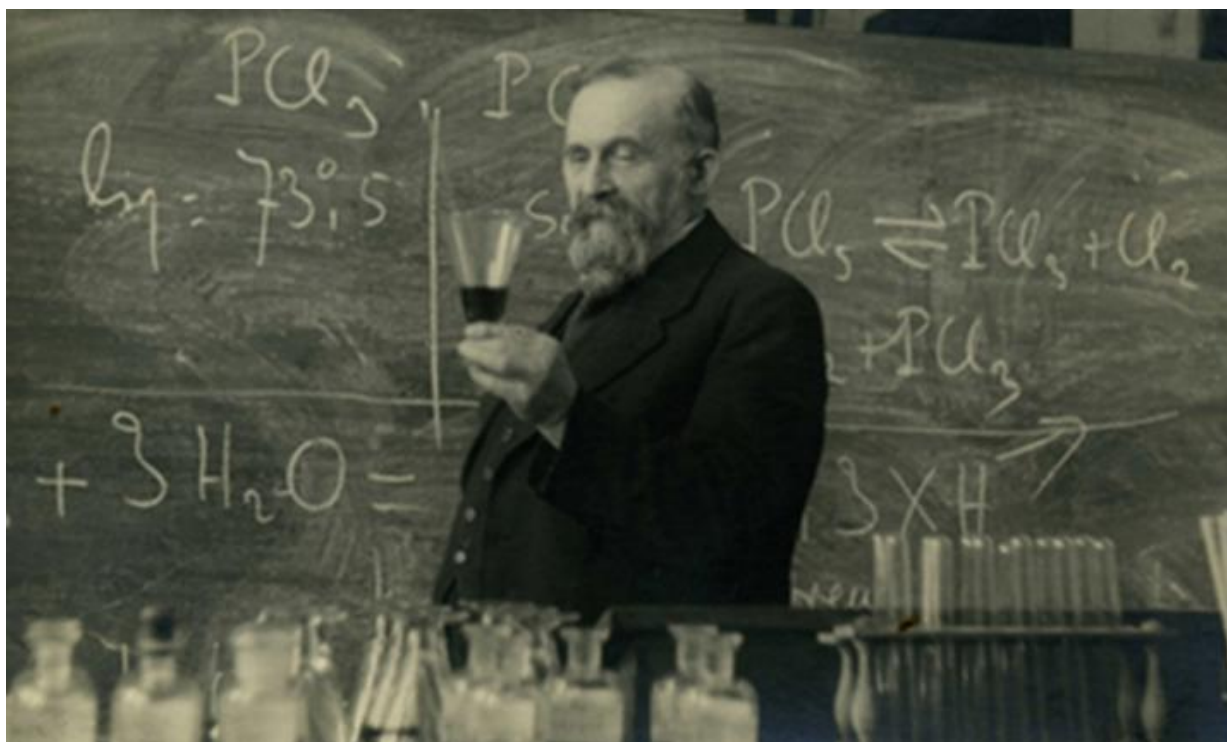


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 **Lhoist**



## Georges Chavanne: 1875-1941





## Personal and academic life timeline

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- 1875: birth in Hôpitaux-Neufs (France)
- 1899: graduated teacher in Physical Sciences at the Sorbonne
- 1904: graduated Doctor in Physical Sciences
- 1905: moved to the University of Brussels as lecturer of the General Chemistry Chair
- 1908: promoted as extraordinary professor
- 1908: wedding with Marie François
- 1910: promoted as ordinary professor
- 1914-1918: career at the University of Brussels interrupted by World War I





## Personal and academic life timeline

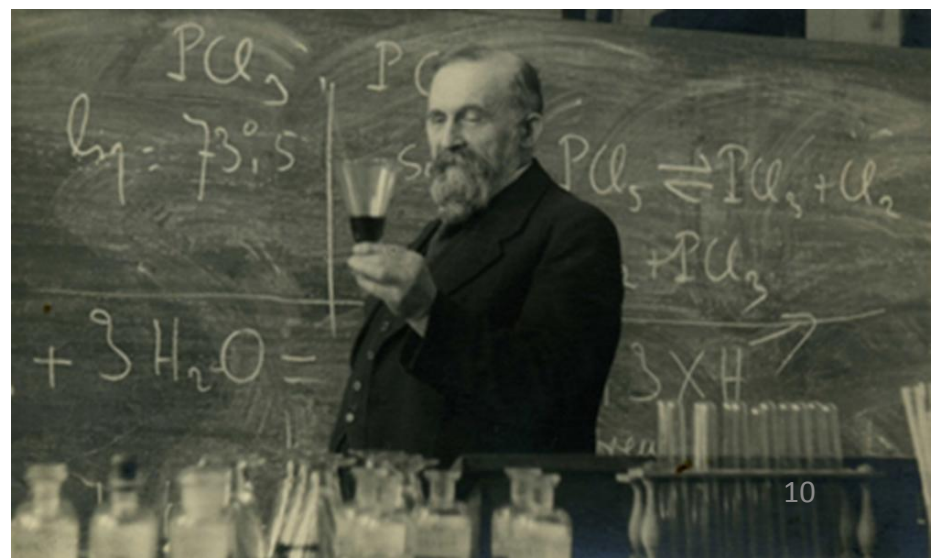
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- 1914-1921: President of the Chemical Society of Belgium
- 1919-1921: Dean of the Faculty of Sciences
- 1937: his wife passed away
- 1937: granted a patent for a “Procedure for the Transformation of vegetable oils for their uses as fuels”
- 1940: left Belgium after the closing of the University of Brussels on May 11
- 1941: back to Belgium on July 14 and died on July 29 at the age of 66



## Personal character and recognitions

- Excellent teacher
- In charge for 35 years of the General Chemistry Chair
- Fruitful influence on the teaching of chemistry at the University of Brussels
- Powerful leader in the field of research
- Respected and beloved school leader





# Personal character and recognitions

- Awarded the Cahours and Jecker prize by The Academy of Sciences of Paris
- Associate member of the Science Class of the Royal Academy of Belgium
- Member of Honour of the industrial chemistry society
- Member of the Administrative Commission of the Solvay Institutes





## World War I

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- Served first as a sergeant in the French army and became second lieutenant
- Left the front in April 1915
- Spent 3 months in the gunpowder factory of Angoulême
- Moved to the war laboratory of the Ecole Normale Supérieure
- Development of analytical methods to characterize fuel oils used on the front



## Scientific Work

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- Started with his PhD thesis on structure determination and reactivity of isopyromucic acid
- Development of an analytical process to identify and quantify the halogen content in organic substances
- Research work focused on three different domains:
  - The study of hydrocarbons and fuel oils
  - The study of ethylenic isomers
  - The study of spontaneous oxidation of hydrocarbons



## Scientific Work

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- World War I: analysis of fuels oils for aircrafts. Development of an analytical process combining fractional distillation with the determination of the critical solution temperature
- Determination of physical constants of hydrocarbons
- Showed that dimethylcyclohexane obtained from the three isomers of xylene are not pure substances
- Determination of the composition of the most volatile fraction (37-81°C) of an oil originating from Borneo and observed the presence of all the possible hexane isomers
- Resin gasoline: isolated 1,2-dimethylcyclopentene in the 104-105,5°C fraction and produced by hydrogenation the 2-dimethyl-1-cyclopentane *cis* and *trans*



## Scientific Work

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- Interwar years: quest for energy security of supply, independence from import and military considerations
- August 31 1937, Chavanne was granted a patent for “Procedure for the Transformation of vegetable oils for their use as fuels”

Ministère  
des Affaires Économiques

Administration  
du Commerce Intérieur

SERVICE  
DE LA PROPRIÉTÉ INDUSTRIELLE  
ET COMMERCIALE

No. 462.877.

ROYAUME DE BELGIQUE



## BREVET D'INVENTION

Le Ministre des Affaires Économiques

Vu la loi du 24 mai 1854;

Vu le procès-verbal dressé le 28 juillet

1937, à 16 h -

au greffe du Gouvernement provincial du Brabant;

### ARRÊTE:

Article 1. — Il est décerné à M<sup>r</sup> Ch. G. Chauxmire,  
82, rue Berchem, à Saint-Gilles - Bruxelles,  
repr. par M<sup>r</sup> G. Nander Haeghen à Bruxelles

un brevet d'invention pour: Procédé de transformation et huiles  
sigillées en vue de leur utilisation comme carburants.

Article 2. — Ce brevet lui est décerné sans examen préalable, à ses risques et périls, sans garantie soit de la réalité, de la nouveauté ou du mérite de l'invention, soit de l'exactitude de la description, et sans préjudice du droit des tiers.

Au présent arrêté demeure joint un des doubles de la spécification de l'invention (mémoire descriptif et éventuellement dessins) signés par l'intéressé et déposés à l'appui de sa demande de brevet.

Bruxelles, le 31 août 1937.

Au nom du Ministre et par délégation  
Le Directeur général du Commerce Intérieur

Le Directeur, Chef de Service:

*E. Van der*

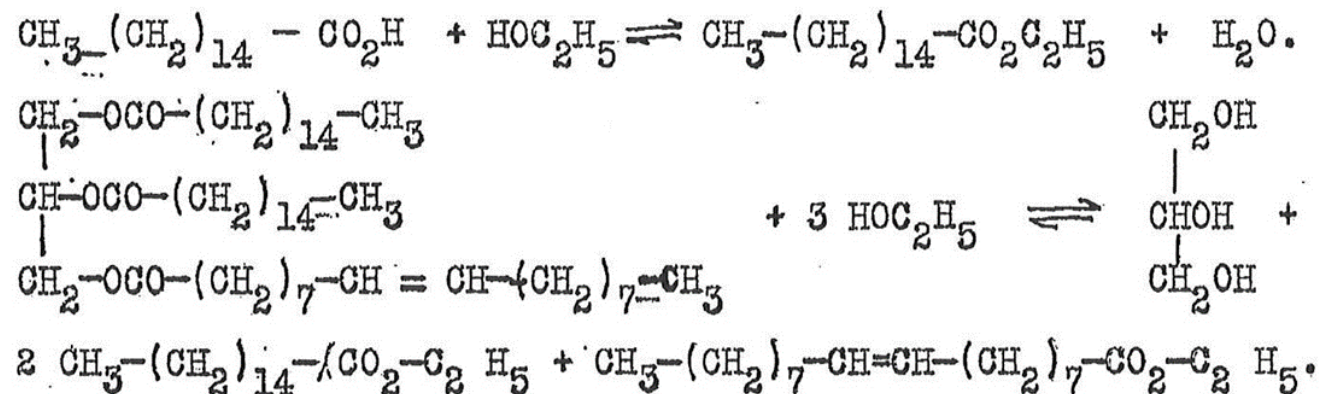




- Years 1900: interest in vegetable oils for use as transport fuel of power production in tropical regions
- Vegetable oils have some unfavourable characteristics when used directly as fuels:
  - high acidity
  - easy freezing
  - high viscosity
  - low volatility



- The patent describes the alcoholysis (transesterification) of vegetables using ethanol or methanol in order to separate the glycerol from the fatty acids by replacing it by short linear alcohols





The process converts vegetable oils in fuel:

- of virtually zero acidity,
  - which does not freeze at low temperature (tropical regions),
  - with a viscosity similar to heavy petroleum fuels,
  - with significant volatility and no solid residue.
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- Clear advantage over natural oils
  - Advantage over heavy petroleum fuels: less complex composition, narrower boiling temperature range.



## First practical application in Belgium

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- Study published in Bulletin agricole du Congo belge, 1942, **33**, 3-90
- Belgian Congo was the first manufacturer of palm oil, used by the soap and oil industry
- Evaluate the possibility to use biodiesel in colder climates
- 1938: first bus line using biodiesel between Brussels and Leuven
- 2 months test: 20.000 km and comparison with a standard petrodiesel engine



# First practical application in Belgium

Diesel MIESSE engine 6 cylinders, 8355 CC  
 Personnel: driver, receiver, engineer  
 Passengers: 60

Nationale Maatschappij der Belgische Spoorwegen

Société Nationale des Chemins de fer belges

## AUTOBUS - BRUSSEL (ZUID) - KORTENBERG - LEUVEN BRUXELLES - (Midi) - KORTENBERG - LOUVAIN

Uurregeling van af 15 Mei 1938

Horaires à partir de 15 Mai 1938

	A	B		t <sub>B</sub>	+	+	+	+	+	+	+	+	+	+	+	+
Brussel (Zuid)	—	6.45	7.30	8.0	20.1	20.30	21.0	21.0	21.30	22.0	22.0	22.30	—	23.30	24.0	0.30
Bruxelles (Midi)	—	6.57	7.42	8.12	20.12	20.42	21.12	21.12	21.42	22.12	22.12	22.42	23.4	23.42	0.12	0.42
Schaarboekse Poort	—	7.5	7.50	8.20	20.20	20.50	21.20	21.20	21.50	22.20	22.20	22.50	23.12	23.50	0.20	0.50
Dallijpleats — Place Dattij	—	7.10	7.55	8.25	20.25	20.55	21.25	21.25	21.55	22.25	22.25	22.55	23.17	23.55	0.25	0.55
Brux (Kerk) (Kylies)	—	7.15	8.0	8.30	20.30	21.0	21.30	21.30	22.0	22.30	22.30	23.0	23.22	24.0	0.30	1.0
St-Servas-Woluwe	—	7.22	8.7	8.37	20.37	21.7	21.37	21.37	22.7	22.37	22.37	23.7	23.38	0.7	0.37	1.7
Woluwe-St-Servas	—	7.22	8.7	8.37	20.37	21.7	21.37	21.37	22.7	22.37	22.37	23.7	23.38	0.7	0.37	1.7
Nongem	6.42	7.12	7.27	8.12	8.42	20.42	21.12	21.42	21.42	22.12	22.42	23.12	23.43	0.12	0.42	1.12
Kortenberg (Stationstraat)	6.51	7.21	7.36	8.21	8.51	20.51	21.21	21.51	—	—	22.51	—	—	—	—	—
Voltem	7.5	7.35	7.50	8.35	9.5	21.5	21.35	22.5	—	—	23.5	—	—	—	—	—
Leuven — Louvain	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

	B	A		t <sub>B</sub>	+	+	+	+	+	+	+	+	+	+	+	+		
Leuven — Louvain	—	—	7.15	7.45	8.15	18.45	19.15	19.15	19.45	20.15	20.15	20.45	21.15	21.15	21.45	22.15	—	23.15
Voltem	—	—	7.29	7.59	8.29	18.59	19.29	19.29	19.59	20.29	20.29	20.59	21.29	21.29	21.59	22.29	—	23.29
Kortenberg (Stationstraat)	5.25	6.0	6.15	7.0	7.30	8.0	8.30	19.0	19.30	19.30	20.0	20.30	21.0	21.30	21.30	22.0	22.30	23.0
Nongem	5.29	6.5	6.20	7.15	7.45	8.15	8.45	19.15	—	19.45	20.15	20.45	—	21.15	21.45	—	22.45	23.15
St-Servas-Woluwe	5.35	6.12	6.37	7.20	7.50	8.20	8.50	19.20	—	19.50	20.20	20.50	—	21.20	21.50	—	22.50	23.20
Brux (Kerk) (Kylies)	5.39	6.17	6.42	7.25	7.55	8.25	8.55	19.25	—	19.55	20.25	20.55	—	21.25	21.55	—	22.55	23.25
Dallijpleats — Place Dattij	5.43	6.22	6.47	7.30	8.0	8.30	9.0	19.30	—	20.0	20.30	21.0	—	21.30	22.0	—	23.0	23.30
Schaarboekse Poort	5.50	6.30	6.54	7.38	8.0	8.38	9.0	19.38	—	20.0	20.38	21.0	—	21.38	22.0	—	23.0	23.38
Bruxel (Zuid)	—	6.42	7.5	7.50	8.20	8.50	9.20	19.50	—	20.20	20.50	21.20	—	21.50	22.20	—	23.20	23.50
Bruxelles (Midi)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

+ Diensten ingericht op Zon- en feestdagen.  
 Services mis en marche les dimanches et jours fériés.

+ Diensten afgehaald op Zon- en feestdagen.  
 Services supprimés les dimanches et jours fériés.

De spoorwegaansluitingen en biljetten zijn niet geldig. — Les abonnements et les billets de chemin de fer ne sont pas valables.

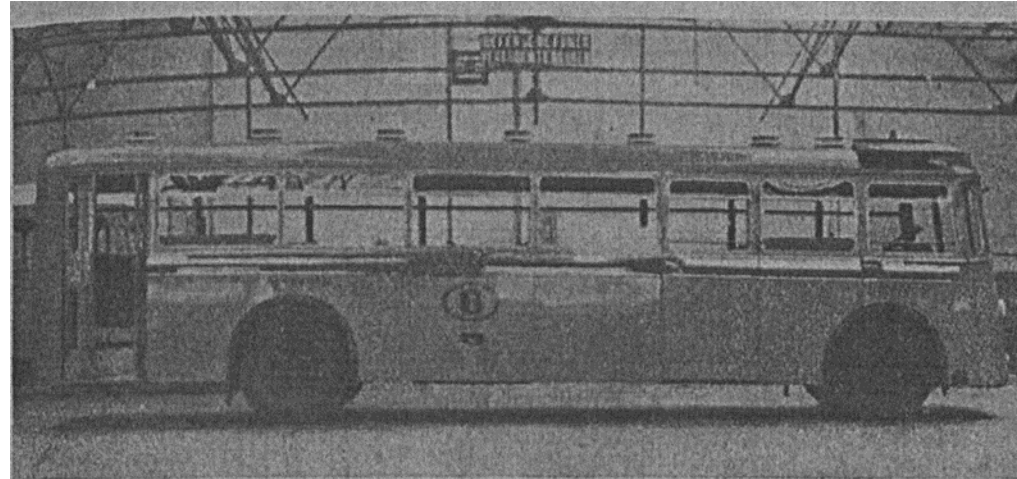
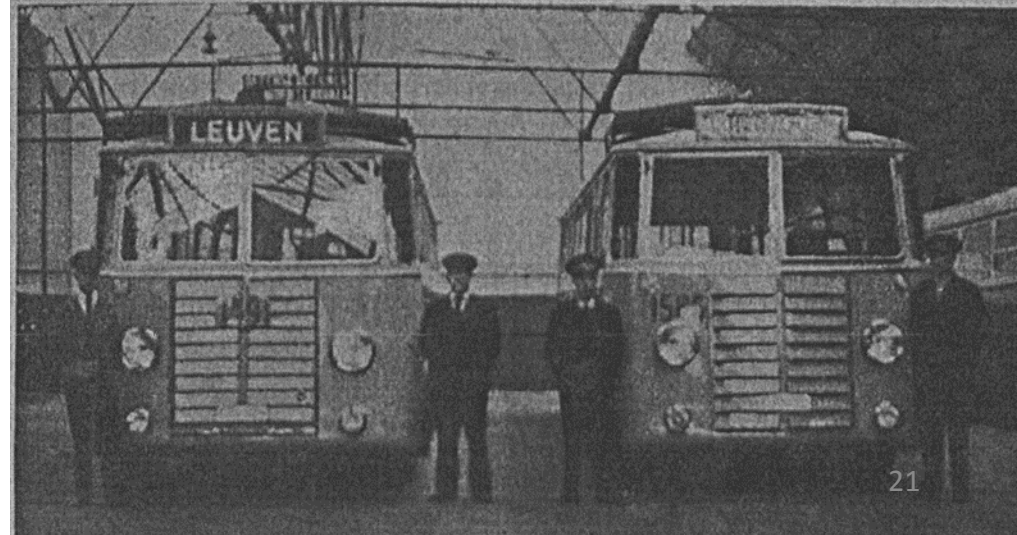


Fig. 17.





## First practical application in Belgium

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Conclusion of 2 months and 20.000 km real life test:

- No issue observed
- Better cold start with biodiesel
- Less noisy engine with biodiesel
- Less deposit with biodiesel
- Night garage temperature should not go below 9°C
- Test stopped in October because of low temperatures
- WWII and post war period with cheap fossil fuels were pushing renewables out of the market





## Georges Chavanne and biodiesel: Conclusion

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- Major invention, maybe coming too early
- Not reported in most of the Chavanne's biographies
- In line with today concern: green chemistry, sustainable development, bioeconomy and circular economy.



## Certech Mission

To provide help, support and services to small and large industrial enterprises by offering ad hoc analysis and measurements, problem-solving, contract research, product and process development capabilities.

## Certech Vision

Delivering innovative and sustainable chemical solutions for product and process improvement or development, in order to meet future societal and industrial needs.





# Contract research organisation providing support to industries

## Services

Analytical support  
Problem solving  
Quality control  
Regulatory assessment

## Industrial projects

Product/process development  
Product/process improvement

## Collaborative projects

Competence development  
Product development  
Process development





# Activities

## ENVIRONNEMENT

Health & safety | Energy | Recycling

## POLYMER MATERIALS TECHNOLOGY

Barrier materials (packaging & functional coatings)  
(Bio-based) polymers & composites  
Blends & alloys of recyclates

## PROCESS INTENSIFICATION

Continuous processes  
Catalytic pyrolysis & solvolysis  
Inorganic & organic synthesis

## ANALYTICAL SUPPORT

Characterization, problem solving, methods development



Thank You for Your Attention