



## Patent landscape analysis: How to find information on hydrogen peroxide industrial syntheses

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### ABSTRACT

The objective of this presentation is to provide an overview of the methodology employed in patent landscape analyses (PLA), with a particular focus on the patented processes used to produce hydrogen peroxide.

Patents are an essential source of technical knowledge that may not be found anywhere else. In a paper published in World Patent Information it is posited that 57 % of technical information can be found exclusively in patents. Even if the quantity of information is difficult to quantify, the rising number of patent applications demonstrates the growing importance of patents as a source of information.

A patent landscape is a specific type of patent search conducted with the objective of identifying the most recent inventions or to study the development of a particular technology.

An example of PLA is reported, focused on the industrial production of hydrogen peroxide. The search was carried out using a combination of classification schemes (IPC – International Patent Classification and CPC – Cooperative Patent Classification) and keywords.

The global patent landscape is dominated by China, the USA and Japan. The patenting trend indicates a rise in the number of filings for electrolytic and photocatalytic methods, with a notable acceleration in the latter.

These results can be beneficial for researchers and technology transfer professionals. Researchers may utilize these findings to develop new photocatalytic methods or enhance the alkyl anthraquinone auto-oxidation (AO) process, focusing on the catalytic systems and reactors utilized for the hydrogenation step, for example.

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## Figures and tables

The screenshot shows the EPO Classification Search interface. The search term 'hydrogen peroxide' is entered in the search box. The results are displayed in a table with columns for 'Classification symbol', 'Title and description', and 'Title and description'. The results are sorted by relevance, with the most relevant results at the top. The results include various CPC symbols and their corresponding descriptions, such as A61L 2/00, C02F 1/00, C01B 15/00, H01L 21/00, A01N 59/00, Y02P 20/00, A01P 1/00, B01J 37/00, B01J 23/00, and A61L 22/00.

Classification symbol	Title and description
<input type="checkbox"/> A61L 2/00	Methods or apparatus for disinfecting or sterilising materials or objects other than foodstuffs or contact lenses; Accessories therefor (for contact lenses A61L 12/00; atomisers for disinfecting agents A61M; sterilisation of packages or package contents in association with packaging B65B 55/00; treatment of water, waste water, sewage or sludge C02F; disinfecting paper D21H 21/36; disinfecting devices for water closets E03D; articles having provision for disinfection, see the relevant subclasses for these articles, e.g. H04R 1/12)
<input type="checkbox"/> C02F 1/00	Treatment of water, waste water, or sewage (C02F 3/00 - C02F 9/00 take precedence)
<input type="checkbox"/> C01B 15/00	Peroxides; Peroxyhydrates; Peroxyacids or salts thereof; Superoxides; Ozonides
<input type="checkbox"/> H01L 21/00	Processes or apparatus adapted for the manufacture or treatment of semiconductor or solid state devices or of parts thereof
<input type="checkbox"/> A01N 59/00	Biocides, pest repellants or attractants, or plant growth regulators containing elements or inorganic compounds
<input type="checkbox"/> Y02P 20/00	Technologies relating to chemical industry
<input type="checkbox"/> A01P 1/00	Disinfectants; Antimicrobial compounds or mixtures thereof
<input type="checkbox"/> B01J 37/00	Processes, in general, for preparing catalysts; Processes, in general, for activation of catalysts
<input type="checkbox"/> B01J 23/00	Catalysts comprising metals or metal oxides or hydroxides, not provided for in group B01J 21/16 (B01J 21/16 takes precedence)
<input type="checkbox"/> A61L 22/00	Aspects relating to methods or apparatus for disinfecting or sterilising materials or objects

Fig. 1. The retrieval of CPC symbols can be achieved through the utilization of the “Classification search” tool, which is provided by the European Patent Office (EPO). In order to facilitate the retrieval process, it is sufficient to input a couple of keywords, which will then generate a list of results. Subsequently, it is necessary to ascertain whether the retrieved codes are pertinent.

<input type="checkbox"/> C01B 15/01	• Hydrogen peroxide
<input type="checkbox"/> C01B 15/013	•• Separation; Purification; Concentration
<input type="checkbox"/> C01B 15/0135	••• {Purification by solid ion-exchangers or solid chelating agents}
<input type="checkbox"/> C01B 15/017	••• Anhydrous hydrogen peroxide; Anhydrous solutions or gaseous mixtures containing hydrogen peroxide
<input type="checkbox"/> C01B 15/022	•• Preparation from organic compounds
<input type="checkbox"/> C01B 15/023	••• by the alkyl-anthraquinone process
<input type="checkbox"/> C01B 15/024	••• from hydrocarbons
<input type="checkbox"/> C01B 15/026	••• from alcohols
<input type="checkbox"/> C01B 15/027	•• Preparation from water
<input type="checkbox"/> C01B 15/0275	••• {Preparation by reaction of water, carbon monoxide and oxygen}
<input type="checkbox"/> C01B 15/029	•• Preparation from hydrogen and oxygen
<input type="checkbox"/> C01B 15/0295	••• {by electrical discharge}
<input type="checkbox"/> C01B 15/03	•• Preparation from inorganic peroxy compounds, e.g. from peroxyulfates
<input type="checkbox"/> C01B 15/032	••• from metal peroxides
<input type="checkbox"/> C01B 15/037	•• Stabilisation by additives
<input type="checkbox"/> C01B 15/04	• Metal peroxides or peroxyhydrates thereof; {Metal} superoxides; {Metal} ozonides; {Peroxyhydrates thereof}
<input type="checkbox"/> C01B 15/043	•• of alkali metals, alkaline earth metals or magnesium {or beryllium or aluminium}
<input type="checkbox"/> C01B 15/0435	••• {of alkali metals}
<input type="checkbox"/> C01B 15/047	•• of heavy metals
<input type="checkbox"/> C01B 15/0475	••• {of actinides}

Fig. 2. The synthesis of hydrogen peroxide is classified into four main typologies: The first of these is the synthesis of hydrogen peroxide from organic compounds, which is mainly achieved through the alkyl-anthraquinone process (C01B 15/023). The second typology is the synthesis of hydrogen peroxide from water, which can be achieved through the use of photocatalytic processes (C01B 15/027) or by reacting water, carbon monoxide and oxygen (C01B 15/0275). The third typology is the synthesis of hydrogen peroxide from hydrogen and oxygen, which is achieved through a direct synthesis process (C01B 15/029). Finally, the synthesis of hydrogen peroxide can also be achieved from inorganic peroxy compounds (C01B 15/032).

Home > International Patent Classification > IPC Publication

Scheme RCL Compilation Catchwords Search

industrial synthesis of hydrogen peroxide

Search Reset

**IPCCAT**

★ Predictions

5	C01B 15/029
4	B01J 23/44
3	B01J 8/06

IPC HOME | DOWNLOAD

2024.01 Version

English version

French version

Advanced Search

Terms

Cross-references

STATS

IPCCAT

**Categorization (IPCCAT):**

3 Number of predictions

SubG Classification level

English Input language

A01N Start From

**Fig. 3.** The WIPO IPCCAT tool may be utilized in order to retrieve IPC codes. Three parameters can be configured: the number of predictions, the classification level and the language input. The system functions more effectively when an abstract is included. Each result is hyperlinked.

**C25B 1/00** Electrolytic production of inorganic compounds or non-metals

**C25B 1/01** • Products

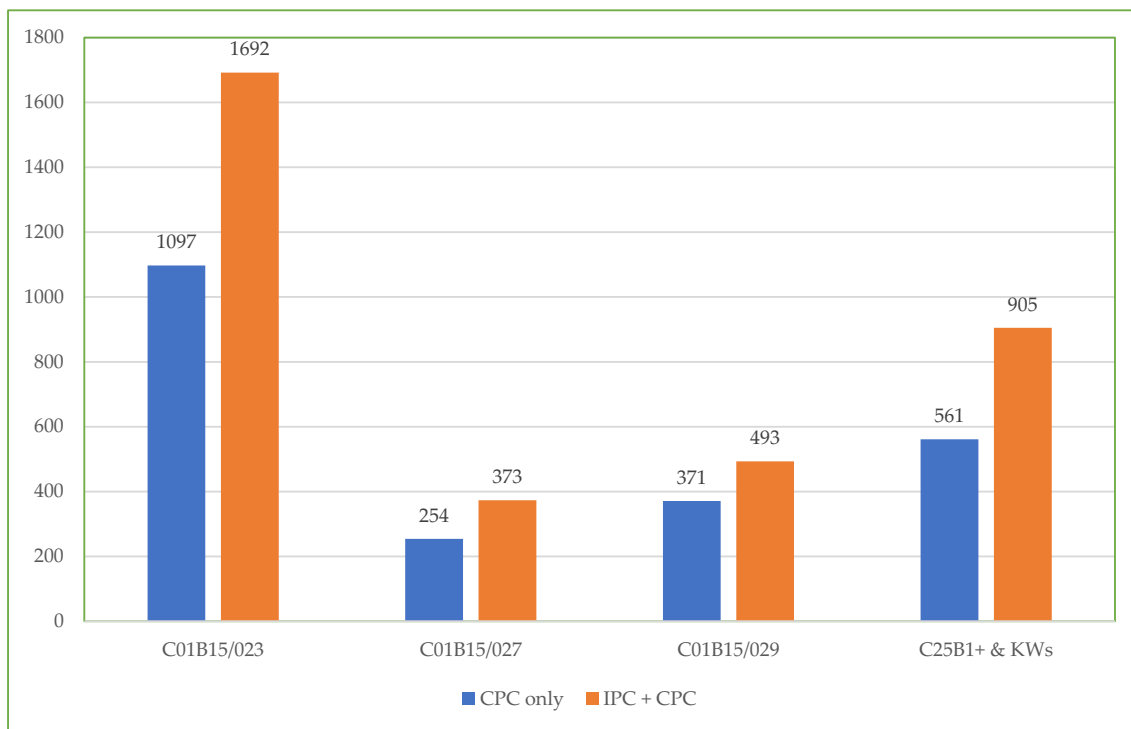
**Warnings**

▲ Group **C25B1/01** is incomplete pending reclassification of documents from group **C25B1/00**. Groups **C25B1/00** and **C25B1/01** should be considered in order to perform a complete search.

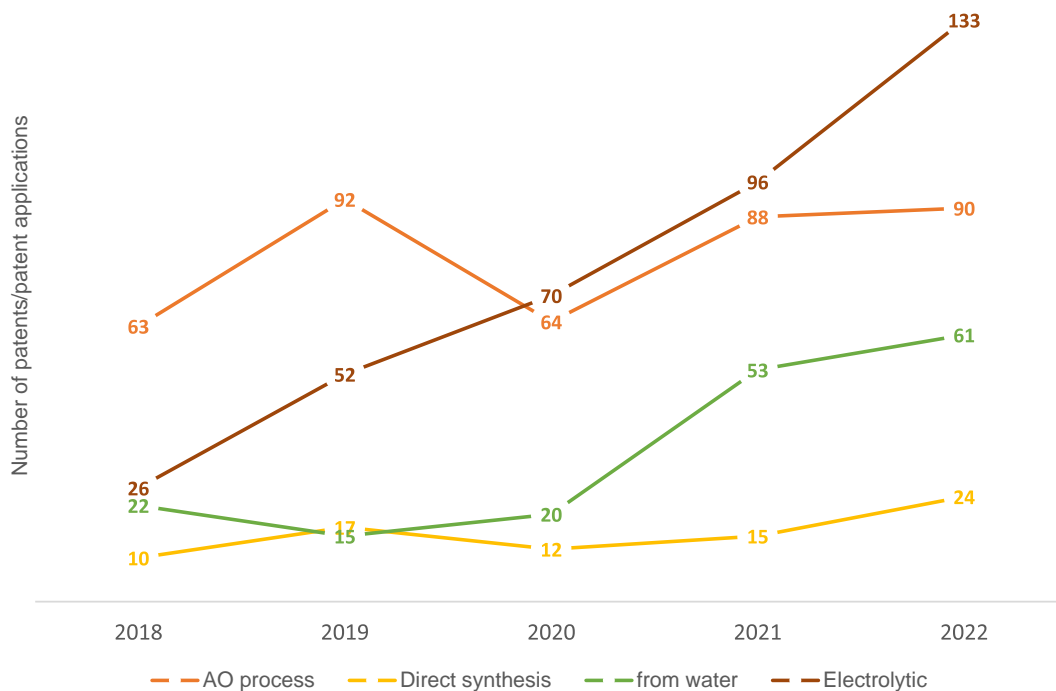
**C25B 1/28** •• Per-compounds

**C25B 1/30** ••• Peroxides

**Fig. 4.** The electrochemical synthesis methods of hydrogen peroxide are not classified in the C01B 15/01 subgroups, but rather in the C25B 1/30 (Electrolytic production of peroxides). To perform a comprehensive search, it is necessary to consider the main groups C25B 1/00 and C25B 1/01, since the reclassification of documents is still pending. C25B 1/30 is referred to as “peroxides” in general, and the terms “hydrogen peroxide” and “H2O2” were used in combination with the classification symbols to obtain a precise search. To retrieve the patented electrolytic processes, the following search query was employed on Espacenet: (*cpc* = “C25B1/30/low” OR *cpc* = “C25B1/00” OR *cpc* = “C25B1/01”) AND *ctxt* = (“hydrogen” prox/ordered “peroxide?”).



**Fig. 5.** It should be noted that not all patent applications are classified in the CPC scheme. Consequently, in order to conduct a comprehensive search, it is necessary to utilize both the IPC and CPC classification systems. The following figure presents a comparison between the number of patents retrieved using CPC alone and those retrieved using both schemes.



**Fig. 6.** The figure illustrates the patenting trend over the period 2018–2022. It can be observed that electrolytic processes are the most patented, followed by photocatalytic methods. However, the AO process continued to be the subject of study and patenting.

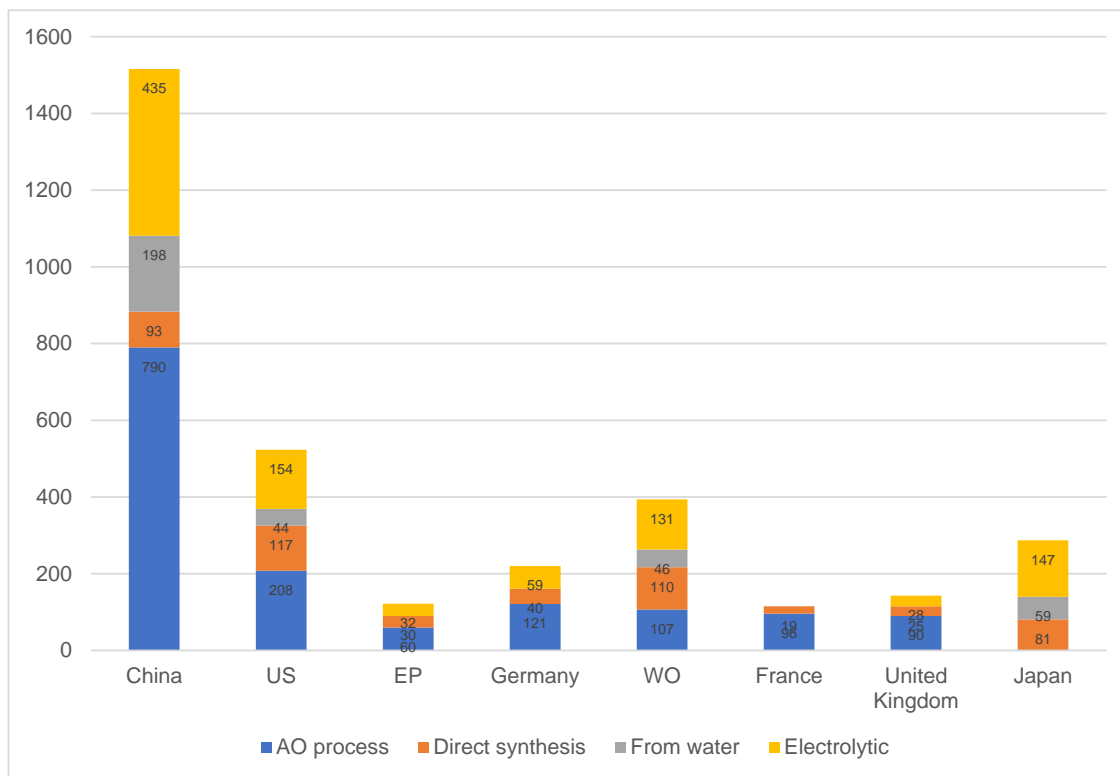


Fig. 7. The following graph presents data related to the number of patents and patent applications filed in the top priority countries. Priority applications are defined as the first filings. Except for the direct synthesis of H<sub>2</sub>O<sub>2</sub>, China ranks first for all processes. The USA, on the other hand, ranks first for direct synthesis.

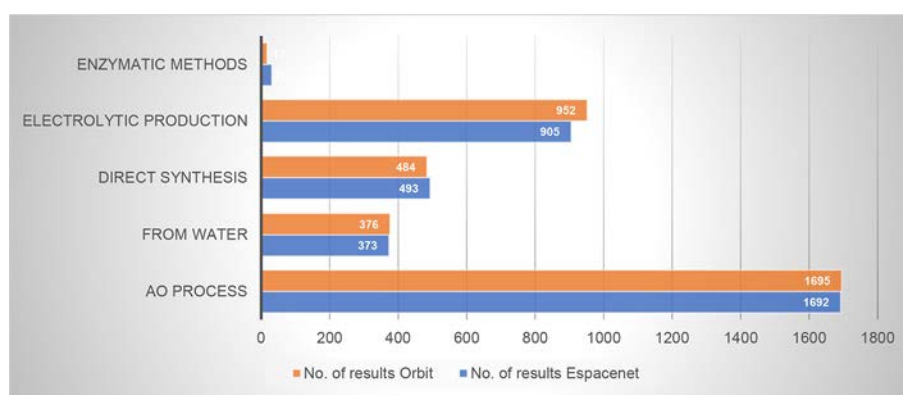
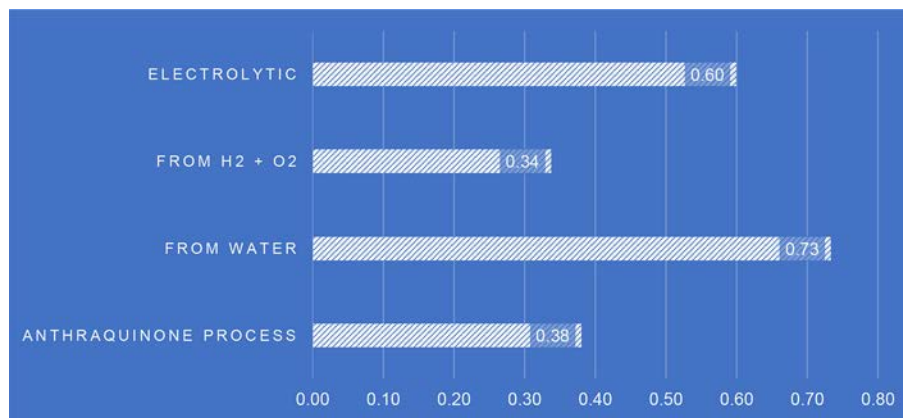


Fig. 8. The total number of patents is reported in this figure. The four main industrial processes previously considered were augmented by the addition of enzymatic methods. However, as can be observed, the number of patents for enzymatic methods is relatively low.



**Fig. 9.** The figure represents the acceleration indicator for each process involved in the production of H<sub>2</sub>O<sub>2</sub>. The acceleration indicator, defined as the ratio between the number of patents with a first application year after 2020 and the number of active patents/patent applications, allows for the identification of patented technologies that have experienced the greatest increase in the number of filings over time. The photocatalytic methods received the most significant impulse, followed by electrolytic methods.

## Conclusions

In this video tutorial, the methodology for conducting a patent landscape analysis is presented. This approach can provide an overview of the patent activity and trends in a given field of technology.

The search for industrial processes for producing hydrogen peroxide was conducted by combining highly precise keywords (utilized in the Title/Abstract/Claims field) and classification symbols (IPC and CPC). Both Boolean and proximity operators were employed. Classification codes constitute a language-independent tool that enables an almost complete recall and retrieval of patent information. Consequently, if classification symbols can be identified, the search will be more comprehensive and accurate.

The patent databases Espacenet and Orbit were utilized in the search.

The global patent landscape is dominated by China, the USA and Japan, as priority countries.

A review of patent data reveals that electrolytic processes are the most patented, followed by photocatalytic methods. However, the AO process remains a subject of ongoing study and patenting.

The findings of this study may prove beneficial to both researchers and technology transfer professionals. Researchers may leverage these findings to develop innovative photocatalytic methodologies or optimize the AO process, with a particular focus on the catalytic systems and reactors employed for the hydrogenation stage.

## CRediT authorship contribution statement

**Massimo Barbieri:** Writing – original draft, Methodology, Data curation, Conceptualization.

## Data availability

Data will be made available on request.

## Declaration of interests

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Further reading

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