

A photograph of the Aurora Borealis (Northern Lights) over a lake at night. The sky is dark with a vibrant green and blue aurora. The lights are reflected in the calm water of the lake. In the background, there are dark silhouettes of mountains and a forested ridge.

*Natural or  
Synthetic Menthol*



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# Menthol-Crystal Project, Production, Machinery, Process, Patent, Consultants, Company Profiles, Suppliers, Plant

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## Menthol-Crystal

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#### Project at a Glance

- Menthol crystals are produced through mint essential oil (mentha arvensis) extraction, the oil is quick frozen and the menthol crystallizes out.
- The crystals are crystalline in form, more oblong, similar to rock crystals. They are clear to white with a cool minty fresh

#### Contents on the CD ROM

##### General Information

- Menthol Crystal Fact Sheet
- Menthol Crystal
- Natural Extract Menthol Crystals
- Menthol
- What are menthol crystals used

##### Project

- Manufacturing a variety of Menthol products
- Menthol Crystals

##### Plant



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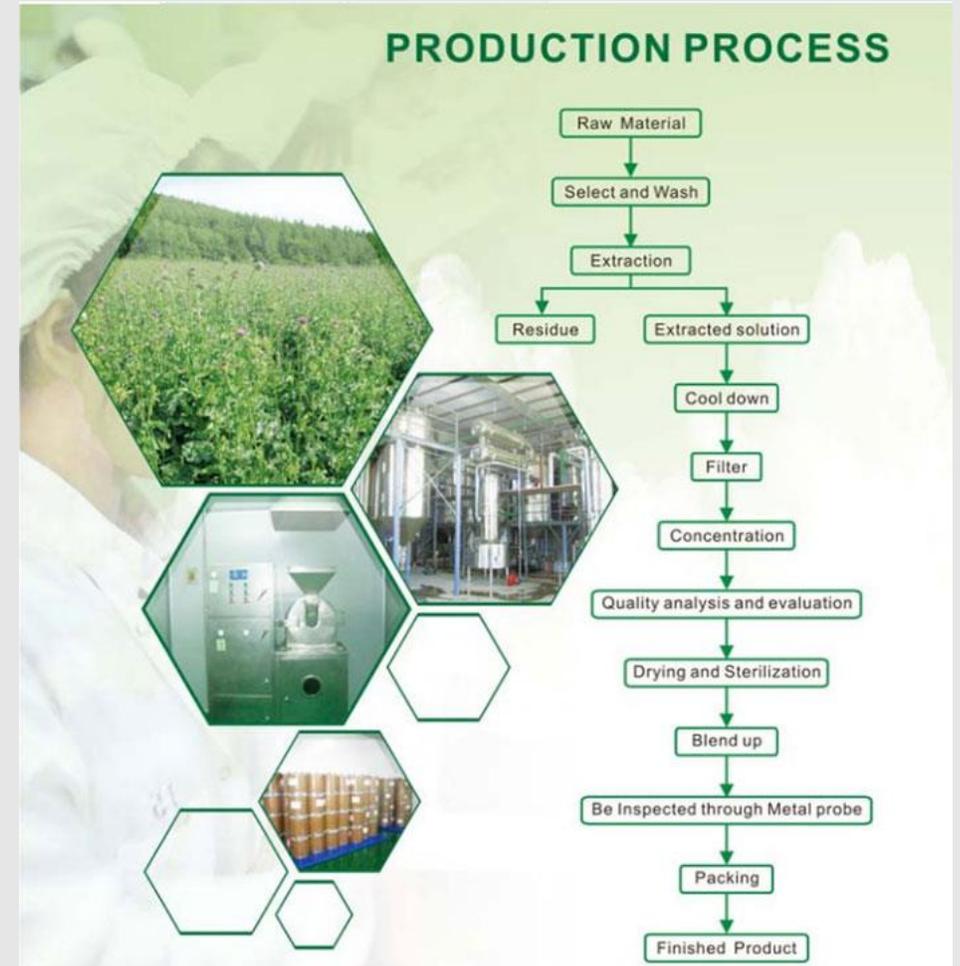


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# *Natural Menthol*

**Menthol crystals are produced through mint essential oil (mentha arvensis) extraction, the oil is quick frozen and the menthol crystallizes out.**



# Synthetic Menthol Project, Technology , Patents, Market, Companies

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## Synthetic Menthol

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Information at a Glance	Contents on the CD ROM	
<ul style="list-style-type: none"><li>• Synthetic menthol has been made according to various processes</li><li>• Synthesize of menthol from thymol, piperitone, pulegone and d-citronellal is well known</li><li>• However, all these synthetic menthols have taste and odor characteristics differ materially from those of the natural product obtained by known means from American, Chinese or Japanese peppermint oils.</li><li>• It is noted that de-neomenthol has a</li></ul>	<h4 style="text-align: center;">Basics</h4> <ul style="list-style-type: none"><li>• About Menthols</li><li>• Chiral chemistry in flavours &amp; fragrances</li></ul> <h4 style="text-align: center;">Product Information</h4> <ul style="list-style-type: none"><li>• Menthol</li><li>• Laevo Menthol</li><li>• Menthol PP</li></ul>	<h4 style="text-align: center;">Company &amp; Products</h4> <ul style="list-style-type: none"><li>• Major player</li><li>• Financial Report</li><li>• Technology Company</li><li>• Company in Germany</li><li>• Company Expansion</li></ul>

# Production Methods

Today, **Synthetic (-)-menthol** is provided by three major industrial processes

These are the Haarmann & Reimer (or Symrise) process, the Takasago process and the BASF process

Overview of the three actual industrial (-)-menthol synthetic routes, the Haarmann & Reimer (or Symrise) process, the Takasago process and the BASF process is explained in the next page/slide



**Symrise Process (formerly known as Haarmann & Reimer process)**  
(US Patent 3,943,181 (Mar 9 1976)) – In this process (Fig 6.2), **thymol is synthesized from m-cresol**. Catalytic hydrogenation gave a mixture of Menthols from which menthols were first obtained as a racemic mixture by careful fractional distillation. The residual mixture was epimerised to increase the content of racemic menthol using a patented catalytic process. The breakthrough in the process is the resolution of the benzoate ester of the racemate by recrystallization by a process of seeding the concentrate with one pure epimer. The mother liquor that was now rich in the (+) isomer was recycled by taking it back to the distillation cycle. In this process, overall yield of (-)-menthol is about 90%.

**Takasago Process:** In this process a (S)-DINAP catalysed isomerization is the key step

Addition of **lithium amide to Myrcene** gave an addition compound that was isomerised using a chiral ruthenium catalyst. Hydrolysis of the resulting enamine gave an aldehyde citronellal in high enantiomeric purity. This was cyclized by Lewis catalyst. Catalytic reduction of the olefin gave (-)-Menthol<sup>1</sup>.

**CONTINUOUS PROCESS FOR PREPARING MENTHOL IN PURE OR ENRICHED FORM, WIPO Patent Application WO/2009/033870 (03/19/2009).**

**(-)-Menthol from (+)-Limonene**

Limonene is abundantly available from peels of citrus fruits. On selective catalytic reduction with Ra-Ni, it could be reduced to (+)-1-Menthene, which on epoxidation and hydrolysis gave (+)-1-hydroxycarvomenthol. Acylation followed by pyrolysis gave (-)-trans-menth-2-ene-1-ol as the major product. The crude product was solvolysed to give a mixture of piperityl acetates as the allylic migration products. The crude product was distilled at this stage to separate the cis- and trans piperitols. The minor ring contraction product was useful as perfume intermediate elsewhere. The final reduction was achieved by H<sub>2</sub> / Pd-C to give 75% yield of (-)-Menthol after fractional distillation.

# *Natural vs Synthetic*

## *Menthol*

**There are various routes to synthetic menthol with reagents in plentiful supply, and this makes the synthetic option more financially attractive compared with the natural sources that are sensitive to weather and seasonal fluctuations.**

## ESTIMATED PRODUCTION AND CONSUMPTION OF MENTHA OIL

■ Opening Balance ■ Estimated Production ■ Availability ■ Total demand ■ Balance



# Menthol market Scenario

Natural & Synthetic

Decrease in demand for synthetic menthol can happen only if the price difference between natural and synthetic menthol narrows. Since, synthetic menthol is already at lower cost benefit, price gap can be achieved only when natural menthol supply increases / prices decrease, which is unlikely in the short term





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**Thanks**

Questions?