

Homogenizer vs. Overhead Mixer vs. Immersion Blender

Guide to Cosmetic Emulsion Mixing

A homogenizer and an overhead stirring mixer are both useful pieces of cosmetic laboratory equipment, but they perform very different functions.

Understanding when and how to use each one can affect the texture, consistency, appearance, and stability of an emulsion.

What Does Homogeneous Mean?

Homogeneous means uniform throughout.

In a homogeneous cosmetic formulation, ingredients are distributed evenly enough that the product has a consistent:

- Appearance
- Color
- Texture
- Viscosity
- Ingredient distribution
- Performance

An emulsion is not necessarily a true solution.

For example, in an oil-in-water emulsion, tiny droplets of oil are dispersed throughout a continuous water phase.

A lotion may look completely smooth and uniform to the eye while containing millions of microscopic oil droplets.

What Is a Homogenizer?

A laboratory homogenizer commonly uses a rotor-stator mixing system.

The rotor spins rapidly inside a stationary stator. The formulation is drawn into the mixing head and exposed to concentrated mechanical shear.

This helps break larger droplets, particles, or agglomerates (clumps) into smaller sizes.

A homogenizer can:

- Reduce the size of oil droplets.
- Break apart powder agglomerates (clumps).
- Disperse pigments.
- Produce a finer emulsion.
- Improve smoothness.
- Improve uniformity.
- Help produce a more refined cosmetic texture.
- Improve batch-to-batch consistency when processing is controlled.

Main Mixing Action

High shear + droplet and particle-size reduction

How Does a Homogenizer Affect an Emulsion?

When the oil and water phases of an emulsion are first combined, relatively large droplets may initially form.

A homogenizer applies high shear and breaks these droplets into smaller droplets.

This can create an emulsion that is:

- Finer
- Smoother
- More uniform
- More elegant in appearance
- Less grainy
- More consistent
- Potentially more resistant to creaming or separation

However, homogenizing alone cannot make a poorly designed emulsion stable.

Emulsion stability also depends on:

- The emulsifier
- Emulsifier usage rate
- Oil-phase composition
- Oil-phase percentage
- Thickener system
- Processing temperature
- Phase-addition method
- Cooling method

- Final pH
- Packaging
- Storage conditions

More shear does not automatically mean a better emulsion.

What Is an Overhead Stirring Mixer?

An overhead mixer has a motor positioned above the mixing vessel.

A shaft extends into the formulation with an impeller or mixing blade attached to the end.

Common attachments include:

- Propeller
- Paddle
- Turbine
- Anchor
- Sweep blade
- Scraper attachment

An overhead mixer produces bulk circulation throughout the vessel.

An overhead mixer can:

- Circulate the entire batch.
- Blend ingredients uniformly.
- Maintain an even temperature.
- Keep ingredients from settling.
- Support controlled heating and cooling.
- Mix medium- and high-viscosity formulations.
- Incorporate cool-down ingredients gently.

Main Mixing Action

Bulk circulation + blending

How Does an Overhead Mixer Affect an Emulsion?

An overhead mixer moves the formulation throughout the vessel.

It helps:

- Distribute the oil and water phases.
- Move material from the top to the bottom.
- Move material from the vessel walls toward the center.
- Maintain uniform temperature.
- Keep the emulsion moving as it cools.
- Maintain uniformity as viscosity develops.

A standard overhead mixer generally does not reduce oil-droplet size as efficiently as a rotor-stator homogenizer.

Homogenizer vs. Overhead Mixer

Homogenizer	Overhead Mixer
Produces concentrated high shear	Produces bulk circulation
Reduces droplet and particle size	Distributes ingredients throughout the batch
Helps create finer emulsions	Keeps the batch uniform
Commonly used during emulsion formation	Used during heating, blending and cooling
Usually operates at high speed	Excellent for continuous mixing
Excellent for dispersions	Excellent for continuous mixing
Usually used for a shorter processing period	May be used throughout much of the process
Can generate heat	Useful for controlled cooling
May incorporate air if positioned incorrectly	May incorporate air if a deep vortex develops

When Should You Homogenize an Emulsion?

A homogenizer is commonly used around the time the oil and water phases are combined.

General Emulsion Process

1. Prepare the water phase.
2. Prepare the oil phase.
3. Heat the phases as required.
4. Begin mixing the receiving phase.
5. Combine the oil and water phases according to the formulation procedure.
6. Apply controlled homogenization.
7. Stop homogenizing after the desired emulsion has formed.
8. Continue cooling with gentler mixing.
9. Add heat-sensitive cool-down ingredients at the appropriate temperature.
10. Reduce mixing speed as the product thickens and cools.

Important

You generally do **not** need to homogenize continuously throughout the entire cooling process.

High shear is most useful during the period when the emulsion is being formed, and larger droplets are being reduced.

Understanding Mixing Speed

RPM means revolutions per minute.

RPM tells you how many times the shaft or rotor rotates in one minute.

However, RPM alone does not tell you how much shear a formulation receives.

Two mixers operating at the same RPM can produce completely different results.

Shear is also influenced by:

- Rotor diameter
- Blade diameter
- Rotor-stator gap
- Impeller design
- Motor torque
- Batch size

- Vessel dimensions
- Product viscosity
- Mixer position

Important Formulation Principle

Do not transfer a procedure to another machine based only on RPM.

When to Increase Mixing Speed

Increase speed gradually when:

- The phases are not combining evenly.
- Oil remains on the surface.
- Powder remains in clumps.
- The entire batch is not circulating.
- Material remains stationary at the vessel walls.
- Material remains stationary at the bottom.
- A finer dispersion is required.
- The product can tolerate additional shear.

The goal is **effective circulation and dispersion**, not the deepest possible vortex.

When to Decrease Mixing Speed

Reduce speed when:

- The emulsion has formed.
- The desired texture has developed.
- The formulation begins cooling.
- Viscosity begins increasing.
- A deep vortex begins forming.
- Air is being pulled into the formulation.
- Foam develops.
- The product begins splashing.
- Heat-sensitive ingredients are added.
- Fragrance or essential oils are added.
- Encapsulated ingredients are added.
- Shear-sensitive ingredients are added.

As an emulsion cools, emulsifiers, fatty alcohols, waxes, and other structuring ingredients may begin developing the final viscosity and structure.

Aggressive high shear is not always beneficial during this stage.

Avoid Incorporating Air

Both homogenizers and overhead mixers can pull air into a formulation.

Entrapped air can cause:

- Visible bubbles
- Whipped texture
- Foaming
- Inaccurate fill weights
- Inconsistent viscosity readings
- Oxidation concerns
- Difficulty evaluating the true texture

To Reduce Air Incorporation

- Keep the homogenizer head fully submerged.
 - Avoid operating the homogenizer close to the surface.
 - Avoid creating a deep vortex.
 - Use the lowest speed that provides effective mixing.
 - Make sure the vessel is appropriately sized for the batch.
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Cosmetic Formulations Commonly Made with a Homogenizer

A laboratory homogenizer may be useful for:

- Facial moisturizers
 - Facial creams
 - Body lotions
 - Body creams
 - Hair conditioners
 - Leave-in conditioners
 - Co-washes
 - Emulsified hair masks
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- Cream cleansers
 - Cream masks
 - Emulsified scalp treatments
 - Tinted moisturizers
 - Liquid foundations
 - Pigmented cosmetic products
 - Powder dispersions
 - Pigment dispersions
 - Clay dispersions
 - Certain gum and polymer dispersions
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Cosmetic Formulations Commonly Made with an Overhead Mixer

An overhead stirring mixer may be used for:

- Lotions
- Creams
- Hair conditioners
- Hair masks
- Shampoos
- Body washes
- Facial cleansers
- Micellar cleansers
- Toners
- Liquid serums
- Gel serums
- Styling gels
- Edge gels
- Cream masks
- Clay masks
- Body scrubs
- Scalp scrubs
- Anhydrous body butters
- Suspensions
- Pilot batches

The correct impeller should be selected according to the formulation viscosity and desired flow pattern.

Can an Immersion Blender Replace a Homogenizer?

For small laboratory batches, an **immersion blender** can be an economical substitute for a laboratory homogenizer.

An immersion blender is also called a:

- Stick blender
- Hand blender
- Wand blender

It contains a rotating blade inside a protective housing.

The blade draws material toward the mixing head, cuts and circulates the product, and pushes it back into the vessel.

An immersion blender can be useful for:

- Small lotion batches
- Small cream batches
- Hair conditioners
- Cream masks
- Cream cleansers
- Student laboratory work
- Early formulation prototypes

However, an immersion blender does not perform exactly like a laboratory rotor-stator homogenizer.

Immersion Blender vs. Laboratory Homogenizer

Immersion Blender	Laboratory Homogenizer
Rotating blade inside a housing	Rotor spinning inside a stator
Moderate and variable shear	Concentrated high shear
Limited speed control	Precise speed control
RPM often unavailable	RPM commonly displayed
Can make good small emulsions	Produces finer, more controlled emulsions
More operator-dependent	Easier to standardize
Greater potential for air incorporation	Air can be controlled with proper positioning
Lower cost	Higher cost
Excellent starting option	Better for professional R&D
Good for prototypes	Better for repeatability and scale-up

How Does an Immersion Blender Perform on an Emulsion?

An immersion blender can produce a smooth and stable emulsion when:

- The formula is well designed.
- The emulsifier is easy to process.
- The batch is small.
- The phases are at the correct temperature.
- The blender head remains submerged.
- The operator uses a consistent technique.

However, compared with a laboratory homogenizer, the resulting droplets may be larger and less uniform.

Possible differences include:

- Slightly heavier texture
- Less refined skin feel
- Greater batch variation
- More visible air
- Greater operator dependence
- Less predictable scale-up

This does **not** mean an immersion-blended emulsion will automatically be unstable. It means the process may be less precise and less reproducible.

Best Practices When Using an Immersion Blender

1. Use a tall, narrow vessel.
 2. Keep the blender head submerged.
 3. Begin at a lower speed when possible.
 4. Avoid rapidly moving the blender up and down.
 5. Avoid creating a deep vortex.
 6. Use short, controlled blending periods.
 7. Stop periodically to inspect the emulsion.
 8. Transition to gentler mixing during cooling.
 9. Record the blender model and speed setting.
 10. Record the processing time.
 11. Dedicate the blender exclusively to cosmetic formulation.
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Which Mixer Does What?

Homogenizer

Think: Fine + High Shear

Use it when you want to:

- Reduce droplet size
- Break up agglomerates
- Create a fine dispersion
- Refine an emulsion

Overhead Mixer

Think: Circulate + Maintain

Use it when you want to:

- Move the entire batch
- Maintain uniformity
- Control cooling
- Mix thickening products

Immersion Blender

Think: Small-Batch Alternative

Use it when you want to:

- Make small prototypes
- Learn emulsion making
- Test early formulations
- Substitute for a laboratory homogenizer when necessary

The Most Important Principle

A cosmetic formula is more than a list of ingredients and percentages.

The **manufacturing process is part of the formula.**

Always document:

- Equipment used
- Mixing attachment
- Speed
- Mixing time
- Homogenizing time
- Temperature
- Batch size
- Vessel dimensions
- Mixer position
- Order of ingredient addition
- Cooling procedure

The goal is not to use the highest possible speed.

The goal is to use the correct amount of mixing and shear at the correct stage of the formulation process.

LEARN COSMETIC FORMULATION

You can learn to formulate. Whether your goal is to create products for yourself, start a beauty brand, or become a professional cosmetic formulator, **The Formulators LAB / Joan Morais Cosmetics School** can help you build the skills step by step.

Have questions or wondering which course is right for you? We're happy to help. Email us anytime at info@joanmorais.com—we'd love to hear from you.