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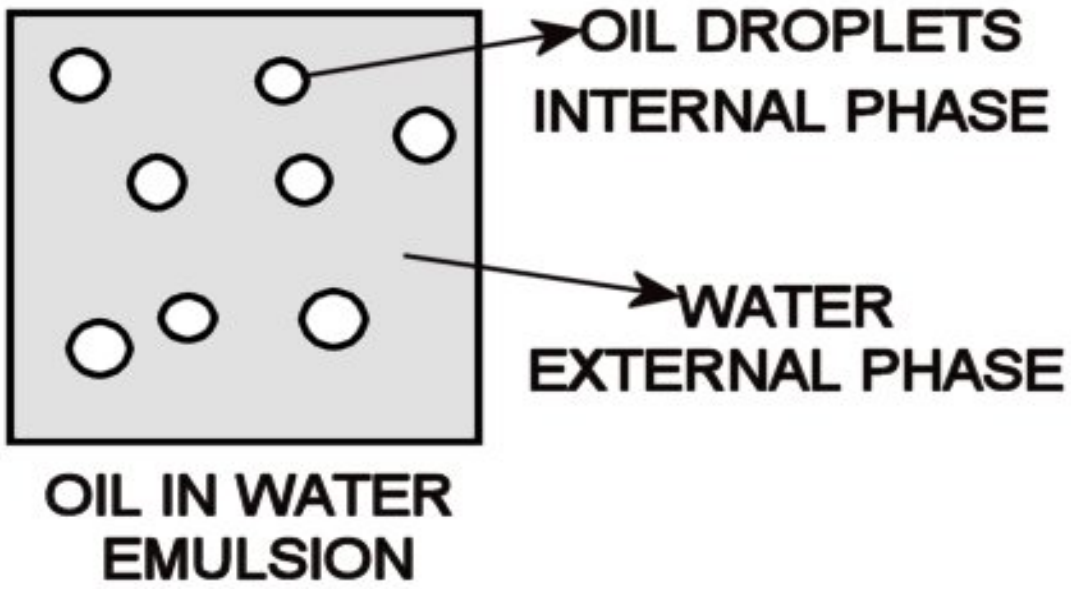
Emulsions and the HLB System

All creams and lotions have one thing in common. They are both emulsions.

An emulsion is a system of two (or more) immiscible materials (usually liquids) in which one material (the dispersed/internal phase) is suspended or dispersed throughout another material (the continuous/external phase) in separate droplets.

Most emulsions fall into two different classes, oil in water emulsions and water in oil emulsions.

In oil in water emulsions, we have hundreds of tiny oil droplets surrounded by water.



In water in oil emulsions, we have the opposite situation. We have hundreds of water droplets surrounded by oil.

One of the simplest emulsions is a simple vinegar and oil salad dressing. One of the problems with this simple emulsion is that the oil and vinegar don't mix. To emulsify the vinegar into the oil, we can use an egg yolk. Egg yolks contain a natural emulsifier call Lecithin.

Most creams and lotions on the market today are oil in water emulsions.

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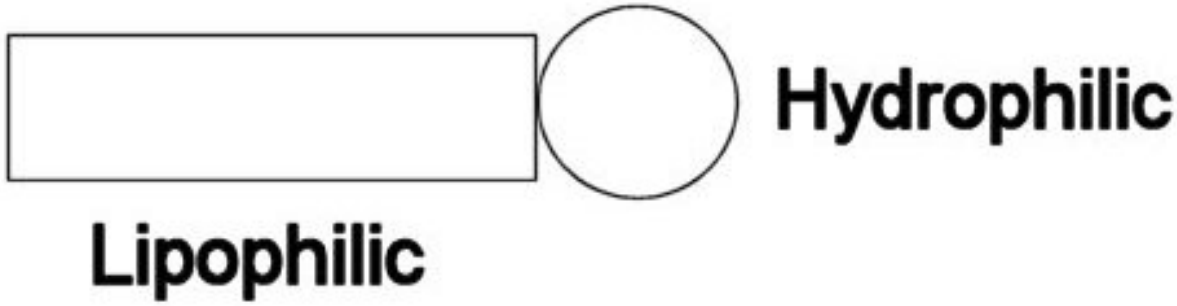
In 1949, William C. (Bill) Griffin developed the Hydrophile-Lipophile Balance System or HLB System when he was a chemist at the Atlas Powder Company, which eventually became ICI Surfactants and is part of Uniqema today.

All emulsifier have two parts; like a bar magnet. A bar magnet has a north pole and a south pole. Nonionic emulsifiers also have two poles or parts.

An emulsifier molecule has one part that loves water and one part loves oil. The water loving part is called hydrophilic; "hydro-` meaning water and "-philic" meaning to love or like.

The other part of the emulsifier molecule is lipophilic; if "lipo-" means fat or oil, then lipophilic means oil loving.



Therefore, an emulsifier has a hydrophilic part and a lipophilic part. The balance of these two portions of the emulsifier gives us the Hydrophile-Lipophile Balance (HLB). The HLB of emulsifiers can be calculated or determined through trial and error.

According to the HLB System, all fats and oils have a Required HLB. For example, if I wanted to emulsify Soybean Oil, which has a required HLB of7, I would need to use an emulsifier or blend of emulsifiers that had a HLB of 7 $\pm$ 1.

Before we can select our emulsifiers that we will need, we must know the required HLB of our oil phase.

Let's start calculating the required HLB of an Oil Phase.

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Below is a list of oils and waxes and their respective required HLBs.

INCI Nomenclature [RHLB ± 1]

Aleurites Moluccana Seed Oil [7]
Almond Oil NF [6]
Anhydrous Lanolin USP [10]
Apricot Kernel Oil [7]
Avocado (Persea Gratissima) Oil [7]
Babassu Oil [8]
Beeswax [12]
Borage (Borago Officinalis) Seed Oil [7]
Brazil Nut Oil [8]
C12-15 Alkyl Benzoate [13]
Cannabis Sativa Seed Oil [7]
Canola Oil [7]
Caprylic/Capric Triglyceride [5]
Carrot (Daucus Carota Sativa) Seed Oil [6]
Castor (Ricinus Communis) Oil [14]
Ceresin [8]
Cetearyl Alcohol [15.5]
Cetyl Alcohol [15.5]
Cetyl Esters [10]
Cetyl Palmitate [10]
Coconut Oil [8]
Daucus Carota Sativa (Carrot) Root Extract [6]
Diisopropyl Adipate [9]
Dimethicone [5]
Dog Rose (Rosa Canina) Hips Oil [7]
Emu Oil [8]
Evening Primrose Oil [7]
Grape (Vitis Vinifera) Seed Oil [7]
Hybrid Safflower (Carthamus Tinctorius) Oil [9]
Isopropyl Myristate [11.5]
Isopropyl Palmitate [11.5]
Jojoba (Buxus Chinensis) Oil [6.5]
Lanolin [10]
Macadamia (Ternifolia) Nut Oil [7]
Mangifera Indica (Mango) Seed Butter [8]
Mineral Oil [10.5]
Myristyl Myristate [8.5]
Olive (Olea Europaea) Oil [7]
Oryza Sativa (Rice Bran) Oil [7]
Peanut Oil NF [6]
Petrolatum [7]
PPG-15 Stearyl Ether [7]
Retinyl Palmitate [6]
Safflower (Carthamus Tinctorius) Oil [8]
Sesame (Sesamum Indicum) Oil [7]
Shea Butter (Butyrospermum Parkii) [8]
Soybean (Glycine Soja) Oil [7]
Stearic Acid [15]
Stearyl Alcohol [15.5]
Sunflower (Helianthus Annus) Oil [7]
Sweet Almond (Prunus Amygdalus Dulcis) Oil [7]
Theobroma Cacao (Cocoa) Seed Butter [6]
Tocopherol [6]

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For the purposes of our calculations, we will assume that 100% of our Oil Phase of our hypothetical emulsion is equal 20%. It could be 18%, 17.85% or 28%.

So, if 100% of our Oil Phase consisted of 20% Soybean Oil, the calculations would be easy. Since the required HLB of Soybean Oil is 7 and 100% of the Oil Phase is Soybean Oil, intuitively we should see that the required HLB of the oil phase is 7.

Let's suppose that your oil phase contains:

Soybean (Glycine Soja) Oil = 15%
Cetyl Alcohol = 5%

The total amount of oils in our Oil Phase = 20%

To calculate the required HLB of our Oil Phase, we must calculate the composition of our Oil Phase in terms of percentage.

But we already know that the total amount of oils in our Oil Phase = 20%
Therefore we can say that 20% of our formula = 100% of the Oil Phase,

If 20% = 100%
and 15% = X %
then X = (100 X 15) / 20
X = 1500 / 20
X = 75%
Therefore Soybean (Glycine Soja) Oil is 75% of the oil phase.

If 20% = 100%
and 5% = X %
then X = (100 X 5) / 20
X = 500 / 20
X = 25%
and Cetyl Alcohol is 25% of the oil phase.

So now, we can say

Soybean (Glycine Soja) Oil = 15% of the formula and 75% of the oil phase.
Cetyl Alcohol = 5% of the formula and 25% of the oil phase.

But we also know that

the required HLB of Soybean (Glycine Soja) Oil is 7
the required HLB of Cetyl Alcohol is 15.5

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To calculate the required HLB of the Oil Phase, we multiply the percentage of each oil, expressed as a number, in the Oil Phase by its respective required HLB and sum the results.

(75%/100) X 7 = 0.75 X 7 = 5.25
(25%/100) X 15.5 = 0.25 X 15.5 = 3.88
The required HLB of our oil phase is the sum of these numbers or 9.13

Let's look at those calculations again. This time let's suppose that your oil phase contains:

Soybean (Glycine Soja) Oil = 18%
Cetyl Alcohol = 2%

The total amount of oils in our Oil Phase = 20%

To calculate the required HLB of our Oil Phase, we must calculate the composition of our Oil Phase in terms of percentage.

But we already know that the total amount of oils in our Oil Phase = 20%
Therefore we can say that 20% of our formula = 100% of the Oil Phase,

If 20% = 100%
and 18% = X %
then X = (100 X 18) / 20
X = 1800 / 20
X = 90%
Therefore Soybean (Glycine Soja) Oil is 90% of the oil phase.

If 20% = 100%
and 2% = X %
then X = (100 X 2) / 20
X = 200 / 20
X = 10%
and Cetyl Alcohol is 10% of the oil phase.

So now, we can say

Soybean (Glycine Soja) Oil = 18% of the formula and 0% of the oil phase.
Cetyl Alcohol = 2% of the formula and 10% of the oil phase.

But we also know that

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the required HLB of Soybean (Glycine Soja) Oil is 7
the required HLB of Cetyl Alcohol is 15.5

To calculate the required HLB of the Oil Phase, we multiply the percentage of each oil in the Oil Phase by its respective required HLB and sum the results.

(90%/100) X 7 = 0.9 X 7 = 6.3
(10%/100) X 15.5 = 0.1 X 15.5 = 1.55

The required HLB of our oil phase is the sum of these numbers or 7.85

Let's make the Oil Phase more complex. Let's suppose that your oil phase contains:

Soybean (Glycine Soja) Oil	11%
Caprylic/Capric Triglyceride	5%
Grape (Vitis Vinifera) Seed Oil	1%
Jojoba (Buxus Chinensis) Oil	1%
Tocopherol	0.5%
Beeswax	0.5%
Cetyl Alcohol	1%

The total amount of oils in our Oil Phase = 20%

To calculate the required HLB of our Oil Phase, we must calculate the composition of our Oil Phase in terms of percentage.

But we already know that the total amount of oils in our Oil Phase = 20%
Therefore we can say that 20% of our formula = 100% of the Oil Phase,

If 20% = 100%
and 11% = X %
then X = (100 X 11) / 20
X = 1100 / 20
X = 55%
Therefore Soybean (Glycine Soja) Oil is 55% of the oil phase.

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If 20% = 100%
and 5% = X %
then X = (100 X 5) / 20
X = 500 / 20
X = 25%
and Caprylic/Capric Triglyceride is 25% of the oil phase.

If 20% = 100%
and 1% = X %
then X = (100 X 1) / 20
X = 100 / 20
X = 5%
and Grape (Vitis Vinifera) Seed Oil is 5% of the oil phase.

If 20% = 100%
and 1% = X %
then X = (100 X 1) / 20
X = 100 / 20
X = 5%
and Jojoba (Buxus Chinensis) Oil is 5% of the oil phase.

If 20% = 100%
and 0.5% = X %
then X = (100 X 0.5) / 20
X = 50 / 20
X = 2.5%
and Tocopherol is 2.5% of the oil phase.

If 20% = 100%
and 0.5% = X %
then X = (100 X 0.5) / 20
X = 50 / 20
X = 2.5%
and Beeswax is 2.5% of the oil phase.

If 20% = 100%
and 1% = X %
then X = (100 X 1) / 20
X = 100 / 20
X = 5%
and Cetyl Alcohol is 5% of the oil phase.

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So now, we can say

Soybean (Glycine Soja) Oil = 11% of the formula and 55% of the oil phase.
Caprylic/Capric Triglyceride = 5% of the formula and 25% of the oil phase.
Grape (Vitis Vinifera) Seed Oil = 1% of the formula and 5% of the oil phase.
Jojoba (Buxus Chinensis) Oil = 1% of the formula and 5% of the oil phase.
Tocopherol = 0.5% of the formula and 2.5% of the oil phase.
Beeswax = 0.5% of the formula and 2.5% of the oil phase.
Cetyl Alcohol = 1% of the formula and 5% of the oil phase.

But we also know that

the required HLB of Soybean (Glycine Soja) Oil is 7
the required HLB of Caprylic/Capric Triglyceride is 5
the required HLB of Grape (Vitis Vinifera) Seed Oil is 7
the required HLB of Jojoba (Buxus Chinensis) Oil is 6.5
the required HLB of Tocopherol is 6
the required HLB of Beeswax is 12
the required HLB of Cetyl Alcohol is 15.5

To calculate the required HLB of the Oil Phase, we multiply the percentage of each oil, expressed as a number, in the Oil Phase by its respective required HLB and sum the results.

(55%/100) X 7 = 0.55 X 7 = 3.85
(25%/100) X 5 = 0.25 X 5 = 1.25
(5%/100) X 7 = 0.05 X 7 = 0.35
(5%/100) X 6.5 = 0.05 X 6.5 = 0.33
(2.5%/100) X 6 = 0.025 X 6 = 0.15
(2.5%/100) X 12 = 0.025 X 12 = 0.3
(5%/100) X 15.5 = 0.05 X 15.5 = 0.78

The required HLB of our oil phase is the sum of these numbers or 7

All we have to do now is find a pair of emulsifiers that will match this required HLB.

There are several nonionic emulsifiers that we could use. Here are two lists of emulsifiers and their respective HLBs.

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Emulsifiers sorted by INCI Name

Calcium Stearoyl Lactylate [HLB = 5.1 ± 1]
Ceteareth-20 [HLB = 15.2 ± 1]
Cetearyl Glucoside [HLB = 11 ± 1]
Ceteth-10 [HLB = 12.9 ± 1]
Ceteth-2 [HLB = 5.3 ± 1]
Ceteth-20 [HLB = 15.7 ± 1]
Cocamide MEA [HLB = 13.5 ± 1]
Glyceryl Laurate [HLB = 5.2 ± 1]
Glyceryl Stearate [HLB = 3.8 ± 1]
Glyceryl Stearate (and) PEG-100 Stearate [HLB = 11 ± 1]
Glyceryl Stearate SE [HLB = 5.8 ± 1]
Glycol Distearate [HLB = 1 ± 1]
Glycol Stearate [HLB = 2.9 ± 1]
Isoceteth-20 [HLB = 15.7 ± 1]
Isosteareth-20 [HLB = 15 ± 1]
Lauramide DEA [HLB = 15 ± 1]
Laureth-23 [HLB = 16.9 ± 1]
Laureth-4 [HLB = 9.7 ± 1]
Lecithin [HLB = 4 ± 1]
Lecithin [HLB = 9.7 ± 1]
Linoleamide DEA [HLB = 10 ± 1]
Methyl Glucose Sesquistearate [HLB = 6.6 ± 1]
Oleth-10 [HLB = 12.4 ± 1]
Oleth-10 / Polyoxyl 10 Oleyl Ether NF [HLB = 12.4 ± 1]
Oleth-2 [HLB = 4.9 ± 1]
Oleth-20 [HLB = 12.4 ± 1]
Oleth-20 [HLB = 15.3 ± 1]
PEG-100 Stearate [HLB = 18.8 ± 1]
PEG-20 Almond Glycerides [HLB = 10 ± 1]
PEG-20 Methyl Glucose Sesquistearate [HLB = 15 ± 1]
PEG-25 Hydrogenated Castor Oil [HLB = 10.8 ± 1]
PEG-30 Dipolyhydroxystearate [HLB = 5.5 ± 1]
PEG-4 Dilaurate [HLB = 6 ± 1]
PEG-40 Sorbitan Peroleate [HLB = 9 ± 1]
PEG-60 Almond Glycerides [HLB = 15 ± 1]
PEG-8 Laurate [HLB = 13 ± 1]
PEG-80 Sorbitan Laurate [HLB = 19.1 ± 1]
Polysorbate 20 [HLB = 16.7 ± 1]
Polysorbate 60 [HLB = 14.9 ± 1]
Polysorbate 80 [HLB = 15 ± 1]
Polysorbate 85 [HLB = 11 ± 1]
Sodium Stearoyl Lactylate [HLB = 8.3 ± 1]
Sorbitan Isostearate [HLB = 4.7 ± 1]
Sorbitan Laurate [HLB = 8.6 ± 1]
Sorbitan Oleate [HLB = 4.3 ± 1]
Sorbitan Sesquioleate [HLB = 3.7 ± 1]
Sorbitan Stearate [HLB = 4.7 ± 1]
Sorbitan Stearate (and) Sucrose Cocoate [HLB = 6 ± 1]
Sorbitan Trioleate [HLB = 1.8 ± 1]
Stearamide MEA [HLB = 11 ± 1]
Steareth-2 [HLB = 4.9 ± 1]
Steareth-21 [HLB = 15.5 ± 1]

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Emulsifiers sorted by HLB Value

Glycol Distearate [HLB = 1 ± 1]

Sorbitan Trioleate [HLB = 1.8 ± 1]

Glycol Stearate [HLB = 2.9 ± 1]

Sorbitan Sesquioleate [HLB = 3.7 ± 1]

Glyceryl Stearate [HLB = 3.8 ± 1]

Lecithin [HLB = 4 ± 1]

Sorbitan Oleate [HLB = 4.3 ± 1]

Sorbitan Stearate [HLB = 4.7 ± 1]

Sorbitan Isostearate [HLB = 4.7 ± 1]

Oleth-2 [HLB = 4.9 ± 1]

Steareth-2 [HLB = 4.9 ± 1]

Calcium Stearoyl Lactylate [HLB = 5.1 ± 1]

Glyceryl Laurate [HLB = 5.2 ± 1]

Ceteth-2 [HLB = 5.3 ± 1]

PEG-30 Dipolyhydroxystearate [HLB = 5.5 ± 1]

Glyceryl Stearate SE [HLB = 5.8 ± 1]

PEG-4 Dilaurate [HLB = 6 ± 1]

Sorbitan Stearate (and) Sucrose Cocoate [HLB = 6 ± 1]

Methyl Glucose Sesquistearate [HLB = 6.6 ± 1]

Sodium Stearoyl Lactylate [HLB = 8.3 ± 1]

Sorbitan Laurate [HLB = 8.6 ± 1]

PEG-40 Sorbitan Peroleate [HLB = 9 ± 1]

Lecithin [HLB = 9.7 ± 1]

Laureth-4 [HLB = 9.7 ± 1]

PEG-20 Almond Glycerides [HLB = 10 ± 1]

Linoleamide DEA [HLB = 10 ± 1]

PEG-25 Hydrogenated Castor Oil[HLB = 10.8 ± 1]

Cetearyl Glucoside [HLB = 11 ± 1]

Polysorbate 85 [HLB = 11 ± 1]

Glyceryl Stearate (and) PEG-100 Stearate [HLB = 11 ± 1]

Stearamide MEA [HLB = 11 ± 1]

Oleth-10 / Polyoxyl 10 Oleyl Ether NF [HLB = 12.4 ± 1]

Oleth-10 [HLB = 12.4 ± 1]

Oleth-20 [HLB = 12.4 ± 1]

Ceteth-10 [HLB = 12.9 ± 1]

PEG-8 Laurate [HLB = 13 ± 1]

Cocamide MEA [HLB = 13.5 ± 1]

Polysorbate 60 [HLB = 14.9 ± 1]

PEG-60 Almond Glycerides [HLB = 15 ± 1]

Isosteareth-20 [HLB = 15 ± 1]

Lauramide DEA [HLB = 15 ± 1]

Polysorbate 80 [HLB = 15 ± 1]

PEG-20 Methyl Glucose Sesquistearate [HLB = 15 ± 1]

Ceteareth-20 [HLB = 15.2 ± 1]

Oleth-20 [HLB = 15.3 ± 1]

Steareth-21 [HLB = 15.5 ± 1]

Ceteth-20 [HLB = 15.7 ± 1]

Isoceteth-20 [HLB = 15.7 ± 1]

Polysorbate 20 [HLB = 16.7 ± 1]

Laureth-23 [HLB = 16.9 ± 1]

PEG-100 Stearate [HLB = 18.8 ± 1]

PEG-80 Sorbitan Laurate [HLB = 19.1 ± 1]

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However, the number of emulsifiers available to most homecrafters is quite limited. As far as I know, the short list includes:

Glyceryl Stearate [HLB = 3.8 ± 1]
Polysorbate 80 [HLB = 15 ± 1]
Ceteareth-20 [HLB = 15.2 ± 1]
Polysorbate 20 [HLB = 16.7 ± 1]

Suppose we want to make a lotion that has an oil phase that has a required HLB of 7

This means that we'll need an emulsifier or emulsifier blend that will have a HLB of 7.

Experiments have shown that you'll get better stability with blends of high HLB and low HLB emulsifiers versus a single emulsifier.

By using blends of

Glyceryl Stearate [HLB = 3.8 ± 1] and Polysorbate 80 [HLB = 15 ± 1]
Glyceryl Stearate [HLB = 3.8 ± 1] and Ceteareth-20 [HLB = 15.2 ± 1]
Glyceryl Stearate [HLB = 3.8 ± 1] and Polysorbate 20 [HLB = 16.7 ± 1]

We can create just about any HLB.

To calculate the HLB of two emulsifiers we multiply the percentage of the emulsifier by the HLB.

We could write an equation that looks like this:

$HLB_{blend} = (\%HLB_1/100) \text{ X } HLB_1 + (\%HLB_2/100) \text{ X } HLB_2$

For this example, we'll use Glyceryl Stearate [HLB = 3.8 ± 1] and Ceteareth-20 [HLB = 15.2 ± 1].

Intuitively, we can sense that if we had

Glyceryl Stearate = 0%
Ceteareth-20 = 100%

the HLB would be 15.2

(0%/100) X 3.8 + (100%/100) X 15.2 = (0 X 3.8) + (1 X 15.2) = 0 + 15.2 = 15.2

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and of course the opposite situation would be true also

Glyceryl Stearate =100%
Ceteareth-20 = 0%

(100%/100) X 3.8 + (0%/100) X 15.2 = (1 X 3.8) + (0 X 15.2) = 3.8 + 0 = 3.8

now what would happen if you had

Glyceryl Stearate = 50%
Ceteareth-20 = 50%

we would have

(50%/100) X 3.8 + (50%/100) X 15.2 = (0.5 X 3.8) + (0.5 X 15.2) = 1.9 + 7.6 = 9.5

Doing the calculations for 5% increments;

(0%/100) X 3.8 + (100%/100) X 15.2 = (0 X 3.8) + (1 X 15.2) = 0 + 15.2 = 15.2
(5%/100) X 3.8 + (95%/100) X 15.2 = (0.05 X 3.8) + (0.95 X 15.2) = 0.19 + 14.44 = 14.6
(10%/100) X 3.8 + (90%/100) X 15.2 = (0.1 X 3.8) + (0.9 X 15.2) = 0.38 + 13.68 = 14.1
(15%/100) X 3.8 + (85%/100) X 15.2 = (0.15 X 3.8) + (0.85 X 15.2) = 0.57 + 12.92 = 13.5
(20%/100) X 3.8 + (80%/100) X 15.2 = (0.2 X 3.8) + (0.8 X 15.2) = 0.76 + 12.16 = 12.9
(25%/100) X 3.8 + (75%/100) X 15.2 = (0.25 X 3.8) + (0.75 X 15.2) = 0.95 + 11.4 = 12.4
(30%/100) X 3.8 + (70%/100) X 15.2 = (0.3 X 3.8) + (0.7 X 15.2) = 1.14 + 10.64 = 11.8
(35%/100) X 3.8 + (65%/100) X 15.2 = (0.35 X 3.8) + (0.65 X 15.2) = 1.33 + 9.88 = 11.2
(40%/100) X 3.8 + (60%/100) X 15.2 = (0.4 X 3.8) + (0.6 X 15.2) = 1.52 + 9.12 = 10.6
(45%/100) X 3.8 + (55%/100) X 15.2 = (0.45 X 3.8) + (0.55 X 15.2) = 1.71 + 8.36 = 10.1
(50%/100) X 3.8 + (50%/100) X 15.2 = (0.5 X 3.8) + (0.5 X 15.2) = 1.9 + 7.6 = 9.5
(55%/100) X 3.8 + (45%/100) X 15.2 = (0.55 X 3.8) + (0.45 X 15.2) = 2.09 + 6.84 = 8.9
(60%/100) X 3.8 + (40%/100) X 15.2 = (0.6 X 3.8) + (0.4 X 15.2) = 2.28 + 6.08 = 8.4
(65%/100) X 3.8 + (35%/100) X 15.2 = (0.65 X 3.8) + (0.35 X 15.2) = 2.47 + 5.32 = 7.8
(70%/100) X 3.8 + (30%/100) X 15.2 = (0.7 X 3.8) + (0.3 X 15.2) = 2.66 + 4.56 = 7.2
(75%/100) X 3.8 + (25%/100) X 15.2 = (0.75 X 3.8) + (0.25 X 15.2) = 2.85 + 3.8 = 6.7
(80%/100) X 3.8 + (20%/100) X 15.2 = (0.8 X 3.8) + (0.2 X 15.2) = 3.04 + 3.04 = 6.1
(85%/100) X 3.8 + (15%/100) X 15.2 = (0.85 X 3.8) + (0.15 X 15.2) = 3.23 + 2.28 = 5.5
(90%/100) X 3.8 + (10%/100) X 15.2 = (0.9 X 3.8) + (0.1 X 15.2) = 3.42 + 1.52 = 4.9
(95%/100) X 3.8 + (5%/100) X 15.2 = (0.95 X 3.8) + (0.05 X 15.2) = 3.61 + 0.76 = 4.4
(100%/100) X 3.8 + (0%/100) X 15.2 = (1 X 3.8) + (0 X 15.2) = 3.8 + 0 = 3.8

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Therefore, the HLB System says that a blend of

Glyceryl Stearate = 70%
Ceteareth-20 = 30%

would be needed to emulsify an oil phase that has a required HLB of 7.

Using our knowledge, let's build a formula on paper. Most commercial creams and lotions have three building bocks:

- Water Phase
- Oil Phase
- Miscellaneous Phase

A typical Water Phase might contain

Water	QS
Humectant	2-7%
Preservative	0.05-1.0%
Thickener	0.1-2%
"Whiffle dust"	QS

a typical Oil Phase might contain:

Emollients	5-10%
"Actives"	Drug level
Antioxidant	0.05-0.2%
Emulsifier (primary)	1-2%
Emulsifier (secondary)	1-2%
Wax	0.5-2%
Silicones	0.5-5%

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And finally, a typical Miscellaneous Phase might contain:

Preservative	qs
Fragrance	0.1-1%
Color	qs

For the purposes of this exercise, let's use this Oil Phase.

Shea Butter (Butyrospermum Parkii) = 1.5%
Avocado (Persea Gratissima) Oil = 2.5%
Sweet Almond (Prunus Amygdalus Dulcis) Oil = 5%
Hemp Seed Oil = 2.5%
Stearic Acid = 3%
Cetyl Esters = 4%
Dimethicone = 4%

Therefore, the total amount of oils in our Oil Phase = 22.5%

To calculate the required HLB of our Oil Phase, we must calculate the composition of our Oil Phase in terms of percentage.

But we already know that the total amount of oils in our Oil Phase = 22.5%
Therefore we can say that 22.5% of our formula = 100% of the Oil Phase,

If 22.5% = 100%
and 1.5% = X %
then X = (100 X 1.5) / 22.5
X = 150 / 22.5
X = 6.67%
Therefore Shea Butter (Butyrospermum Parkii) is 6.67% of the oil phase.

If 22.5% = 100%
and 2.5% = X %
then X = (100 X 2.5) / 22.5
X = 250 / 22.5
X = 11.11%
and Avocado (Persea Gratissima) Oil is 11.11% of the oil phase.

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If 22.5% = 100%
and 5% = X %
then X = (100 X 5) / 22.5
X = 500 / 22.5
X = 22.22%
and Sweet Almond (Prunus Amygdalus Dulcis) Oil is 22.22% of the oil phase.

If 22.5% = 100%
and 2.5% = X %
then X = (100 X 2.5) / 22.5
X = 250 / 22.5
X = 11.11%
and Hemp Seed Oil is 11.11% of the oil phase.

If 22.5% = 100%
and 3% = X %
then X = (100 X 3) / 22.5
X = 300 / 22.5
X = 13.33%
and Stearic Acid is 13.33% of the oil phase.

If 22.5% = 100%
and 4% = X %
then X = (100 X 4) / 22.5
X = 400 / 22.5
X = 17.78%
and Cetyl Esters is 17.78% of the oil phase.

If 22.5% = 100%
and 4% = X %
then X = (100 X 4) / 22.5
X = 400 / 22.5
X = 17.78%
and Dimethicone is 17.78% of the oil phase.

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So now, we can say

Shea Butter = 1.5% of the formula and 6.67% of the oil phase.
Avocado Oil = 2.5% of the formula and 11.11% of the oil phase.
Sweet Almond Oil = 5% of the formula and 22.22% of the oil phase.
Hemp Seed Oil = 2.5% of the formula and 11.11% of the oil phase.
Stearic Acid = 3% of the formula and 13.33% of the oil phase.
Cetyl Esters = 4% of the formula and 17.78% of the oil phase.
Dimethicone = 4% of the formula and 17.78% of the oil phase.

But we also know that

the required HLB of Shea Butter (Butyrospermum Parkii) is 8
the required HLB of Avocado (Persea Gratissima) Oil is 7
the required HLB of Sweet Almond (Prunus Amygdalus Dulcis) Oil is 7
the required HLB of Hemp Seed Oil is 7
the required HLB of Stearic Acid is 15
the required HLB of Cetyl Esters is 10
the required HLB of Dimethicone is 5

To calculate the required HLB of the Oil Phase, we multiply the percentage of each oil (expressed as a number) in the Oil Phase by its respective required HLB and sum the results.

(6.67%/100) X 8 = 0.0667 X 8 = 0.53
(11.11%/100) X 7 = 0.1111 X 7 = 0.78
(22.22%/100) X 7 = 0.2222 X 7 = 1.56
(11.11%/100) X 7 = 0.1111 X 7 = 0.78
(13.33%/100) X 15 = 0.1333 X 15 = 2
(17.78%/100) X 10 = 0.1778 X 10 = 1.78
(17.78%/100) X 5 = 0.1778 X 5 = 0.89

The required HLB of our oil phase is the sum of these numbers or 8.31

If we use Glyceryl Stearate [HLB = 3.8 ± 1] and Ceteareth-20 [HLB = 15.2 ± 1] as our emulsifiers, but we know that:

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(45%/100) X 3.8 + (55%/100) X 15.2 = (0.45 X 3.8) + (0.55 X 15.2) = 1.71 + 8.36 = 10.1
(50%/100) X 3.8 + (50%/100) X 15.2 = (0.5 X 3.8) + (0.5 X 15.2) = 1.9 + 7.6 = 9.5
(55%/100) X 3.8 + (45%/100) X 15.2 = (0.55 X 3.8) + (0.45 X 15.2) = 2.09 + 6.84 = 8.9
(60%/100) X 3.8 + (40%/100) X 15.2 = (0.6 X 3.8) + (0.4 X 15.2) = 2.28 + 6.08 = 8.4
(65%/100) X 3.8 + (35%/100) X 15.2 = (0.65 X 3.8) + (0.35 X 15.2) = 2.47 + 5.32 = 7.8
(70%/100) X 3.8 + (30%/100) X 15.2 = (0.7 X 3.8) + (0.3 X 15.2) = 2.66 + 4.56 = 7.2

So we must use

Glyceryl Stearate = 60%
Ceteareth-20 = 40%

Which will yield a HLB or 8.4 and the required HLB is 8.3.

So our Oil Phase is beginning to take shape:

Shea Butter	1.5%
Avocado Oil	2.5%
Sweet Almond Oil	5.0%
Hemp Seed Oil	2.5%
Stearic Acid	3.0%
Cetyl Esters	4.0%
Dimethicone	4.0%
Glyceryl Stearate	??
Ceteareth-20	??

Before we can calculate the formula percentages for the emulsifiers, Glyceryl Stearate and Ceteareth-20, we must decide on how much emulsifier do we want to use in our formula. I usually start with 2% total emulsifier.

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So

If 100% = 2%
Then 60% Glyceryl Stearate = X
X = (60 X 2)/100
X = 120/100
X = 1.2

Therefore, we need 1.2% Glyceryl Stearate

If 100% = 2%
Then 40% Ceteareth-20 = X
X = (40 X 2)/100
X = 80/100
X = 0.8

Therefore, we will need 0.8% Ceteareth-20.

Our Oil Phase is complete and looks like this:

Oil Phase	
Shea Butter	1.5%
Avocado Oil	2.5%
Sweet Almond Oil	5.0%
Hemp Seed Oil	2.5%
Stearic Acid	3.0%
Cetyl Esters	4.0%
Dimethicone	4.0%
Glyceryl Stearate	1.2%
Ceteareth-20	0.8%

The Water Phase should be easy:

Water Phase	
Water	QS
Glycerin	2.0%
Calendula Extract	2.0%
Aloe Vera Gel	2.0%
Tetrasodium EDTA	0.1%

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And finally, the Miscellaneous Phase:

Miscellaneous Phase	
Germall Plus	0.15%
Fragrance	0.25

Now we can re-write the phases to look like a real formula:

Water Phase	
Water	70.35%
Glycerin	2.00%
Calendula Extract	2.00 %
Aloe Vera Gel	2.00%
Tetrasodium EDTA	0.10%
Oil Phase	
Shea Butter	0.15%
Avocado Oil	2.50%
Sweet Almond Oil	5.00%
Hemp Seed Oil	2.50%
Stearic Acid	3.00%
Cetyl Esters	4.00%
Dimethicone	4.00%
Glyceryl Stearate	1.20%
Ceteareth-20	0.80%
Miscellaneous Phase	
Germall Plus	0.15%
Fragrance	0.25%