leXsolar-BioFuel Ready-to-go

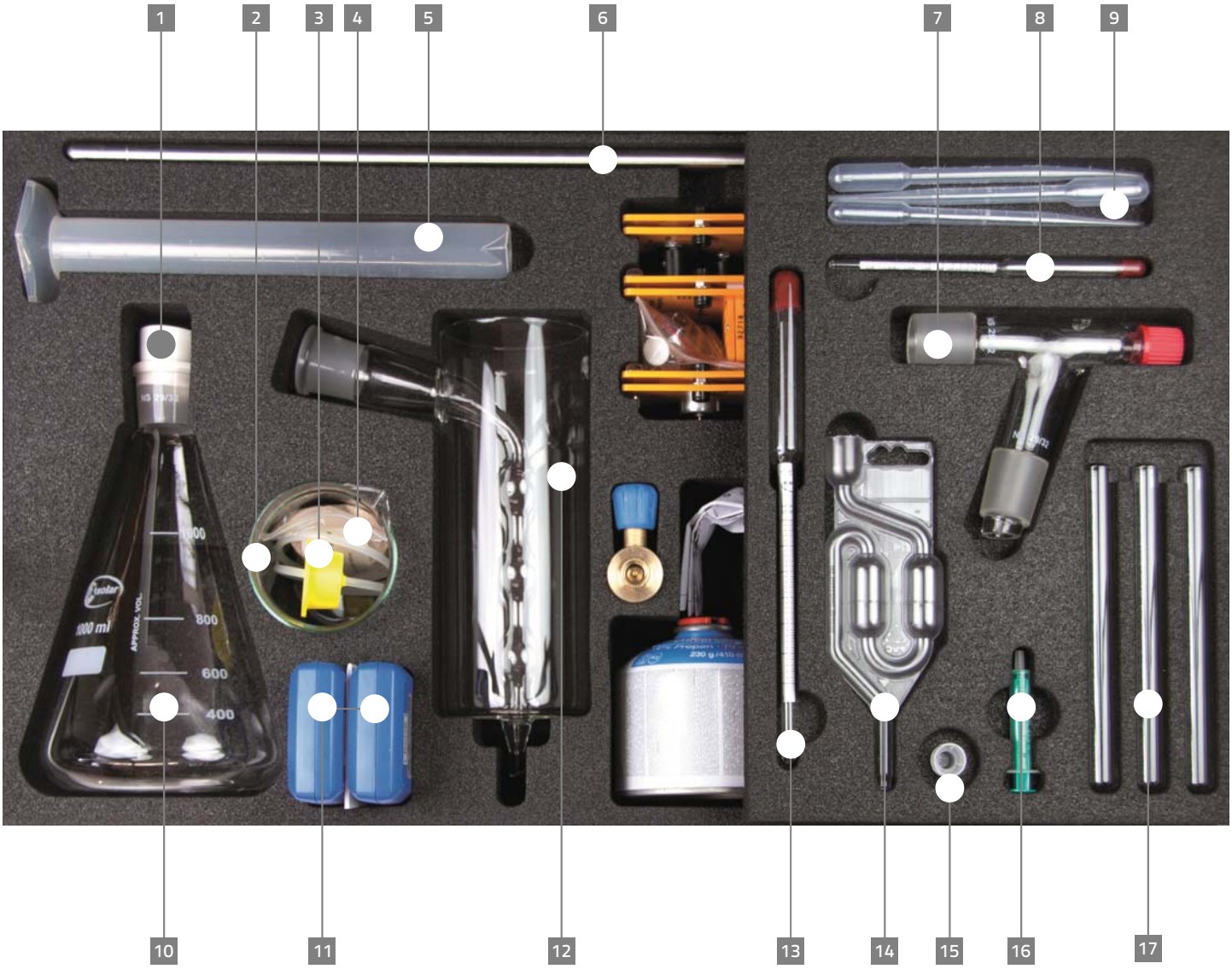
Instructions Manual

Layout diagram leXsolar-BioFuel Ready-to-go

Item-No.1703

Bestückungsplan leXsolar-BioFuel Ready-to-go

Art.-Nr.1703



1 L2-06-077 Rubber stopper
L2-06-077 Gummistopfen

2 L2-06-082 Beaker 250 ml
L2-06-082 Becherglas 250 ml

3 1702-01 Plug with hose
1702-01 Stopfen mit Schlauch

4 1702-02 Yeast
1702-02 Hefe

5 L2-06-086 Measuring cylinder 100ml
L2-06-086 Messzylinder 100ml

6 L2-06-119 Stand rod
L2-06-119 Stativstange

7 L2-06-070 Distilling head with
L2-06-110 Silicone ring
L2-06-070 Destillieraufsatz mit
L2-06-110 Silikonring

8 L2-06-072 Alcoholmeter
L2-06-072 Alkohlmeter

9 3xL2-06-085 Pasteur pipette
3xL2-06-085 Pasteurpipette

10 L2-06-075 Erlenmeyer flask 1000 mL
L2-06-075 Erlenmeyerkolben 1000 mL

11 2xL2-06-011 Digital multimeter
2xL2-06-011 Digitalmultimeter

12 L2-06-071 Condenser
L2-06-071 Kühler

13 L2-06-079 Areometer
L2-06-079 Dichtemessspindel

14 L2-06-076 Airlock
L2-06-076 Gärspund

15 L2-06-084 Grip stopper
L2-06-084 Lamellen Stopfen

16 L2-06-087 Syringe 2 ml
L2-06-087 Spritze 2 ml

17 3xL2-06-083 Test tubes
3xL2-06-083 Reagenzglas

Version number
Versionsnummer

III-01.24_L3-03-175_12.04.2017

CE RoHS2

Layout diagram leXsolar-BioFuel Ready-to-go

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Art.-Nr.1703

18 1100-27 Motor module with L2-02-017 Yellow propeller
1100-27 Motormodul mit L2-02-017 Luftschraube (Propeller) gelb

19 1700-01 Ethanol fuel cell module
1700-01 Ethanol-Brennstoffzellenmodul

20 1100-23 Potentiometer module
1100-23 Potentiometermodul

21 2xL2-06-120 Double clamp
2xL2-06-120 Doppelklemme

22 1700-02 Chain clamp
1700-02 Kettenklemme

23 L2-06-116 Universal stand clamp
L2-06-116 Universalstativklemme

24 2xL2-06-012 Test lead 25cm, black
2xL2-06-012 Messleitung 25cm, schw.
2xL2-06-013 Test lead 25cm, red
2xL2-06-013 Messleitung 25cm, rot

25 L2-06-016 Laboratory thermometer
L2-06-016 Laborthermometer

26 L2-06-114 Bunsen burner*
L2-06-114 Bunsenbrenner*

27 L2-06-118 Stand base plate
L2-06-118 Stativfuß

28 L3-03-016 leXsolar-CD
L3-03-016 leXsolar-CD

*extra needed
*zusätzlich benötigt

CE RoHS2

leXsolar-Bio Fuel Ready-to-go

Students manual

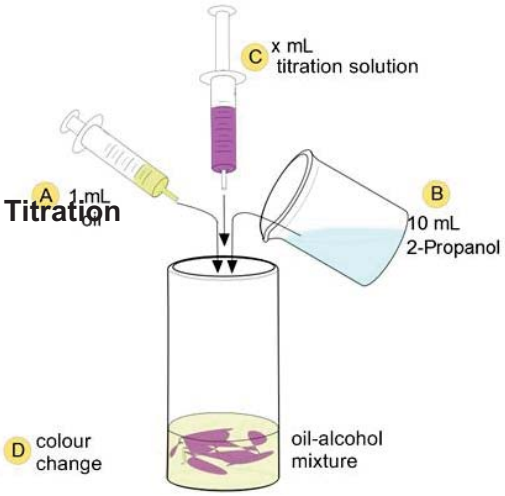
Content

1.1 Production of Biodiesel (FAME) from fats & oils

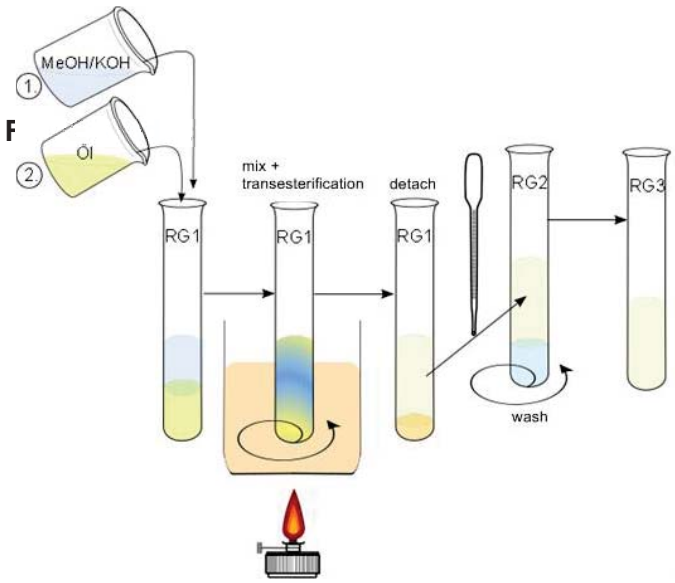
Task

Find out the amount of KOH necessary for the production of FAME by titrating the oil with NaOH stock solution (c = 1g/l) and separate the oil into its two components glycerol and biodiesel (FAME).

Setup



Titration



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Equipment

- beaker
- test tubes
- 10 ml isopropyl alcohol 99 %
- at least 1 ml of oil (45 °C – for titration)
  ~10 ml for transesterification
- phenolphthalein solution (~0.3 %)
- water
- NaOH stock solution (c = 1 g/l)
- 2 x one-way syringes with 5 ml
- pipette
- KOH aqueous stock solution (1 g/l)
- bunsen burner/other heat source
- thermometer
- rubber septum / test tube stopper
- balance (only necessary for fresh preparation of the KOH solution)

Performing

Titration:

1. Measure exactly 1 ml of oil with the one-way syringe/pasteur pipette and add approximately 10 ml isopropyl alcohol to the oil into the beaker.
2. Shortly heat the mixture up to 40 °C. Don't bring it to the boil!
3. Add 3 drops of phenolphthalein to the mixture.
4. Now add the NaOH standard solution by a slight swirling until a permanent pink colour appears in the beaker (at least for 30 seconds). Note the amount used.

Used NaOH standard solution in ml: _____

Hint: At this point, all free fatty acids of the sodium hydroxide solution have been converted into its salts and the pH has increased to 8.5 due to the freely existing OH^- ions. The consumption in ml KOH stock solution now has to be converted to the needed amount KOH according to the table/formula. To ensure exact results, the titration may be conducted several times.

As a rule of thumb, the oil quality can be expressed according to its consumption as follows:
0 – 3 ml excellent quality; suitable for FAME production
3 – 6 ml medium quality; still suitable for FAME production
> 6 ml low quality; unsuitable for FAME production

5. Using the table, now determine the additional necessary amount of KOH for 1 litre of FAME formation.
Determination of the additional necessary amount of NaOH for 1 litre FAME formation

Consumption of stock solution during titration in ml	Additional necessary amount of KOH in g	Total amount of KOH 5 g + X in g	Acid value mg/g oil (density values for the different oils: cf. exp. 1.3 FAME <-> cooking oil, here: 0.92 kg/l)
1.0	1	6	6.5
2.0	2	7	7.6
4.5	4.5	9.5	10.3

6. Fill the necessary amount of methanol and the calculated amount of KOH into the first test tube (TT1) and dissolve it by repeated shaking. It is advisable to calculate the formation for approximately 16 ml of oil due to the typical size of a test tube of 20 ml. Then, enough FAME is produced for all following experiments. The calculation of the proportions is conducted according to the following table:

	Formation for 1000 ml of oil	Formation for 16 ml of oil
oil	1000 ml	16 ml
KOH	5 g + X g (e.g. X = 1 g)	0.1 g + X g
methanol	220 ml	3.5 ml

7. Now fill the desired amount of oil for transesterification into test tube 1 (TT1).
8. Heat the mixture in a bain-marie to approx. 50 °C for approx. 20 minutes and shake the test tube from time to time using a stopper.
9. Let the mixture cool down and wait for phase separation (can take up to one hour).

Performing

Hint: The heavier brownish glycerol (density 1.2) settles on the ground, while the yellowish biodiesel (density 0.9) swims on top.

10. Wait for phase separation and pipette the swimming biodiesel carefully into a new test tube (TT2). Add water to the biodiesel in TT2 until the test tube is nearly full. Carefully turn the test tube several times by 180° head first to wash away excess methanol and catalyst rests. It is also possible to shake it carefully.

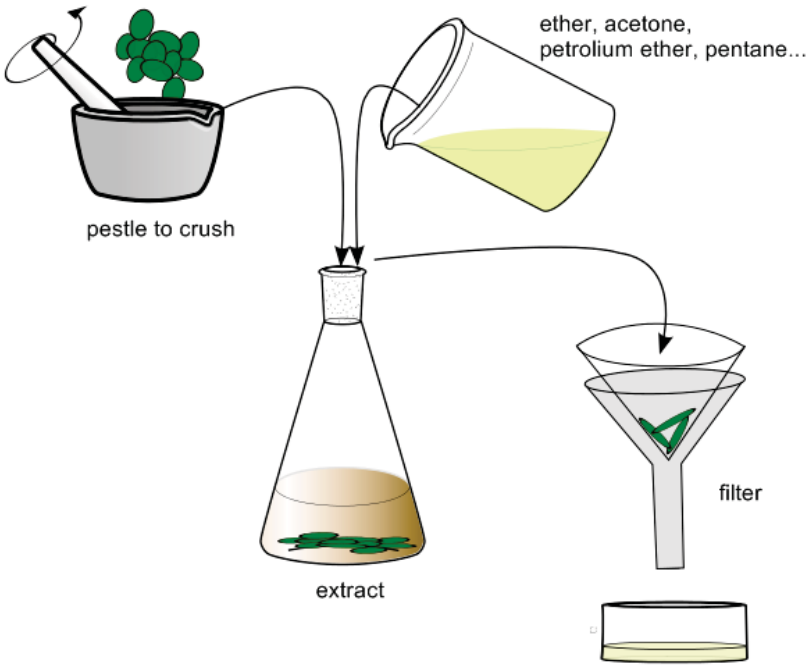
Hint: If the test tube is shaken too heavily, the separation of the two phases may take very long. To detach the solid parts, it can be helpful to additionally filter the FAME/water mixture if the biodiesel does not get clearer during washing.

1.2 Extraction of fats from groceries or oil plants

Task

Extract fats from an oil plant.

Setup



Equipment

- Erlenmeyer flask or beaker
- mortar or other comminution tools
- pentane or adequate solvent (diethyl ether, petroleum ether) for fats (solvent should be well evaporable)
- oil fruits (linseeds, sunflower seeds, rapeseeds,…)
- funnel + paper filters

Performing

1. Crush 10 g of oil fruits in a mortar and mix the fruits well in a beaker/Erlenmeyer flask with 10 – 20 ml of pentane or an adequate solvent.
2. Stir or shake the mixture for 1 – 2 minutes.
3. Separate the solids over the funnel using filter paper and let the collected solvent carefully evaporate (slight heating or blowing, **no open flames!!!**).

Analysis

1. Describe the residue.

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Analysis

Additional task:

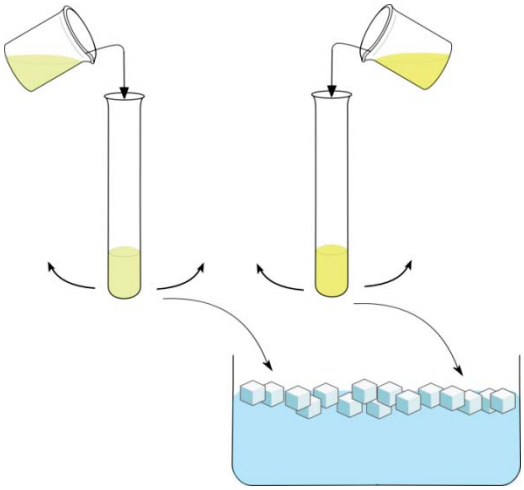
2. How are oils obtained from fruits in reality?

1.3 Differences between cooking oil and FAME

Task

Determine simple differentiation features of cooking oil and FAME.

Setup



Equipment

- FAME
- cooking oil
- 2 test tubes
- icy water or refrigerator

Performing

1. Fill some cooking oil and some FAME each into a test tube and shake them slightly. Note your observations.

2. Put both samples into icy water and compare their cloudiness.

Analysis

1. What can you say about the viscosity of the liquids?