



WORKING WITH REFRACTOMETERS

Refractometers are precise measuring instruments that play a key role in numerous sectors. They make it possible to determine the refractive index of liquids and solids and thus provide important conclusions about their composition, purity and concentration. Due to their fast, non-destructive measuring method, refractometers have established themselves as indispensable tools in industry, laboratories and quality control.

CONTENTS

1. What a refractometer measures	2
2. Binary liquids	2
3. Multi-component liquids (restrictions)	2
4. Ideal sample properties	3
5. Conclusion	3

WORKING WITH REFRACTOMETERS

1. What a refractometer measures

A refractometer measures the refractive index (nD) – i.e. how much the path of light is bent (refracted) when it enters a liquid.

- Light moves slower in liquids than in air
- Dissolved substances change the optical density of the liquid
- More dissolved substances cause stronger refraction of light and a higher refractive index (often shown as a directly readable scale, e.g. Brix, salt content, alcohol, etc. – depending on the device and scale)

2. Binary liquids

A binary liquid has exactly two components (e.g. water + sugar or water + salt).

Take sugar water, for example:

- The more sugar dissolved in the water, the higher the refractive index
- There is a fixed relationship: e.g. 10 g sugar → n = 1.347, 20 g sugar → n = 1.355, etc.
- That means: refractive index ↔ concentration is clear → you can read the concentration directly

3. Multi-component liquids (restrictions)

Multi-component liquids contain more than two active ingredients, e.g.: fruit juice (sugar + acids + minerals + different types of sugars + flavourings)

- Each component influences the refractive index differently
- Different components can balance each other out:
 - e.g. sugar ↑, acid ↓ → refractive index remains similar
- A specific refractive index can therefore match multiple different compositions

Consequence

- Refractometer values mostly serve as total/overall indicators
- (e.g. „soluble solids“ as Brix display),
- but there is no clear determination of an individual substance
- (e.g. „only sugar“) without additional information/calibration

Useful for trend/process control

- Same product, same recipe → changes in values are useful for monitoring
- (e.g. batch consistency, evaporation)
- Further procedures are usually necessary for precise analysis of individual components



4. Ideal sample properties

- Homogeneous: thoroughly mixed, no phase separation, bubble-free, particle-free
- As clear as possible up to slightly cloudy: high turbidity scatters light and can increase measuring errors
- Stable temperature, because the refractive index is temperature-dependent, ideally: sample and device at the same temperature, use ATC (automatic temperature compensation) if necessary
- Prism must be clean, sample should wet the prism completely

Critical/may cause measuring errors

- **Emulsions (oil/water)**, suspensions, very foamy samples
- **Very viscous samples** (e.g. honey, thick syrups) without proper wetting
- **Volatile samples** (evaporation changes concentration)
- **Aggressive samples** (monitor chemical resistance of prism/seal)

Special cases (practical solutions)

- **Emulsions/fatty sauces** (e.g. vinaigrette, creamy sauces)
Fat significantly influences the refractive index and can distort it considerably
>> Cool, skim off the fat or centrifuge briefly; then measure the aqueous phase.
- **Starchy sauces** (e.g. with flour/sauce thickener)
Starches can be dissolved or suspended → distortion due to turbidity/particles
>> Filter/clarify (if necessary, let sample settle for a while + measure clear phase)
- **Very viscous samples** (syrup, honey, thick sauces)
Wetting/bubbles are critical
>> Slightly warm the sample, apply carefully, avoid bubbles



5. Conclusion

HIGHLY SUITABLE

for binary liquids: exact concentration can be determined, as the refractive index only depends on a dissolved substance

NOT SUITABLE

for complex liquids: usually only for approximate values/indicators or trend measurements, as several components influence the refractive index simultaneously

