



## No Improvement with Open Vessels!

Open vessel microwave technology for chemical synthesis does not provide significant benefits over usual oil-bath heating, since the big advantage of superheating chemical reaction mixtures is completely lost. Therefore, dedicated microwave reactors allow sealed vessel operation enabling maximum handling convenience at extreme temperatures and pressures.



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### Save Time → Close Your Vessels!

The great advantages that we get from using dedicated reactors for microwave assisted chemical synthesis is the combination of handling convenience and superheating of reaction mixtures!

The Arrhenius law, a basic principle in natural science, says that **increasing the reaction temperature by 10 °C doubles the reaction rate.**

This means, that only heating to high temperatures can dramatically reduce reaction times. If an **open system** is used, the reachable temperature **is limited to the boiling point of the reaction mixture**, superheating is not possible and reaction times can NOT be further reduced!

Under open vessel conditions the reaction time will not change since the experiment proceeds at the boiling point, regardless whether an oil bath, a microwave or an open flame is used as heat source.

Similar to pressure cooking pots used in the kitchen for decreasing the cooking time, **sealing and pressurizing** a microwave reaction vessel **reduces the reaction time** of a chemical experiment.

### Sealed Vessel Microwave Heating - User Benefits

- Reaction times are dramatically reduced
- Short reaction times improve the economic efficiency
- Results can be obtained within a few minutes
- Suppressed formation of by-products improves product yields
- Temperatures up to 300 °C can be reached
- Pressures up to 80 bar can be reached
- Maximum handling convenience despite extreme conditions is assured

### Good to know

- If an experiment is processed in an open vessel, microwave heating will not help to save time.
- If a vessel is closed, the reaction mixture can be superheated and therefore, the reaction time will be reduced.
- Open vessel microwave heating is only an expensive way of oil-bath heating, since it does not have any scientific advantage over usual open-vessel processing.



### Do you have any questions?

Contact Anton Paar directly:  
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Check out the numerous reports about sealed vessel microwave synthesis on the Anton Paar website