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Potential of combined enzymatic interesterification and fractionation of palm oil and its fractions



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fte

oils & fats

desmet ballestra

Palm oil

- Equatorial regions
- Largest produced vegetable oil in the world (>40 million T/yr)
- Broad spectrum of triglycerides → 'fractions': stearin, olein
- Refined & processed worldwide into frying oils, margarines, baking fats, salad oils…

Modification techniques

- Fractionation: separation of triglycerides by fractional crystallization (sometimes with aid of a solvent)
- Interesterification: re-arrangement of fatty acids of triglycerides

Combining techniques: synergistic effects

EIE

+

Dry Fractionation

- Simple, clean & safe
- No side reactions
- Limited post-treatment
- More healthy, natural

Improvement

on process level (faster process, higher yields…) ?

on product level (cold stability, structural assets…) ?

Fractionation

- Physical process (no chemicals involved)
- Fully reversible
- Limited pre-/post-refining required

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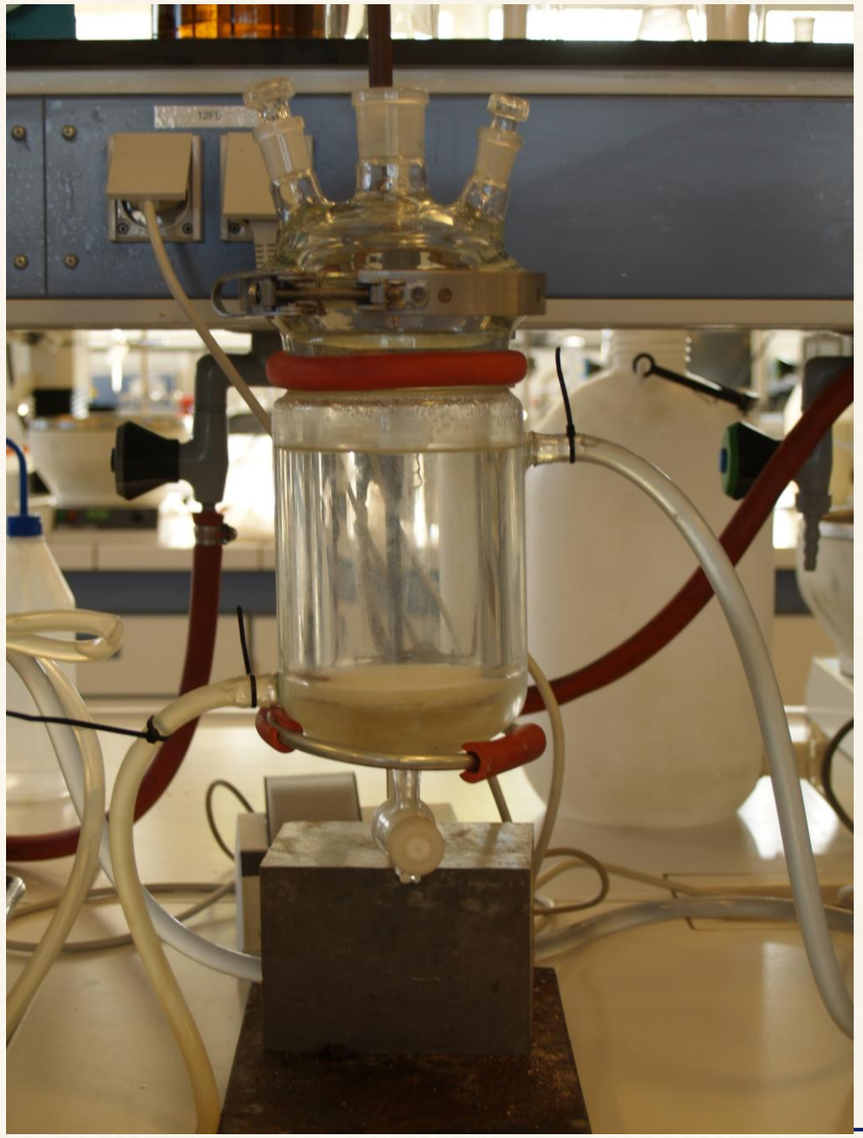
Enzymatic IE (Batch)



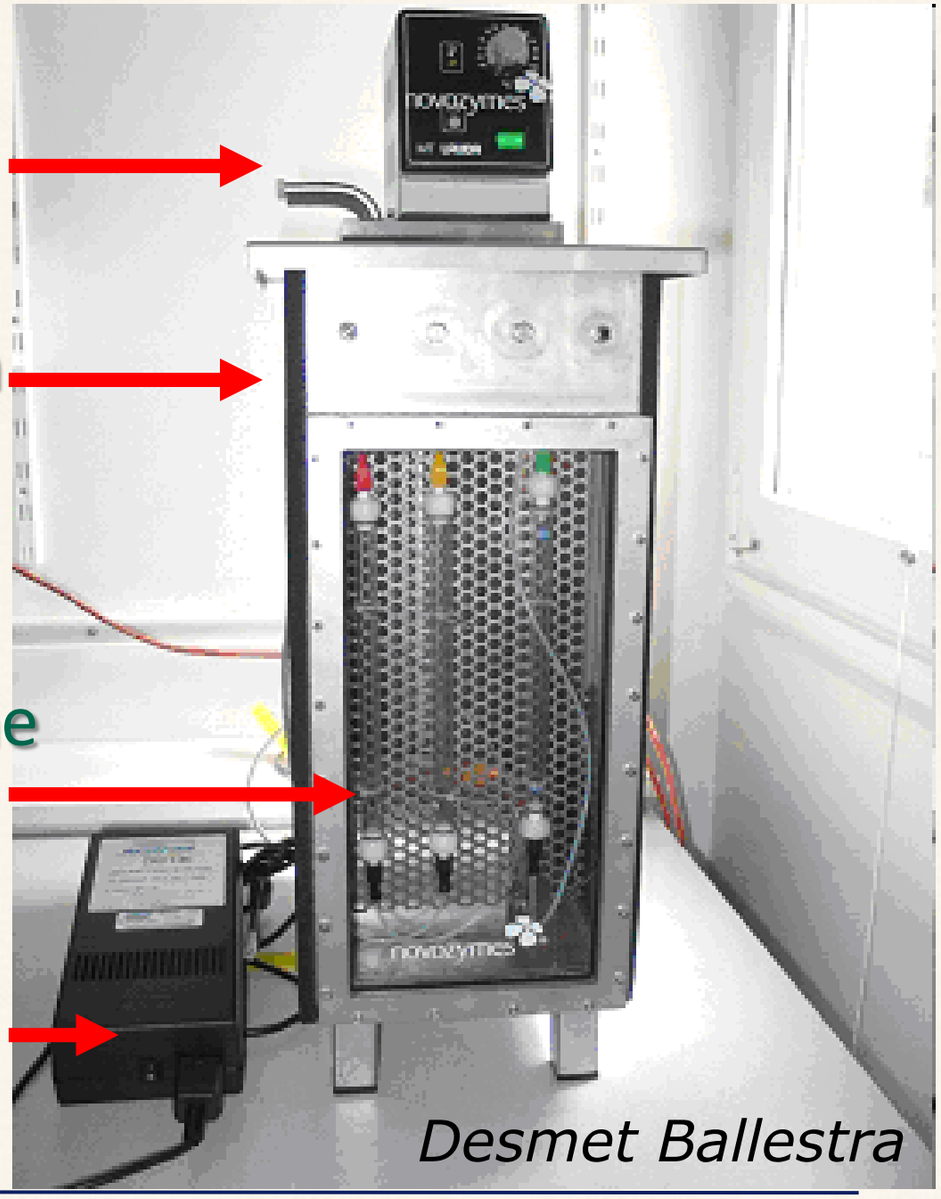
Continuous EIE

Heater

Water bath system (aquarium)

Columns with enzyme (+/- 90 g in both)

Pump



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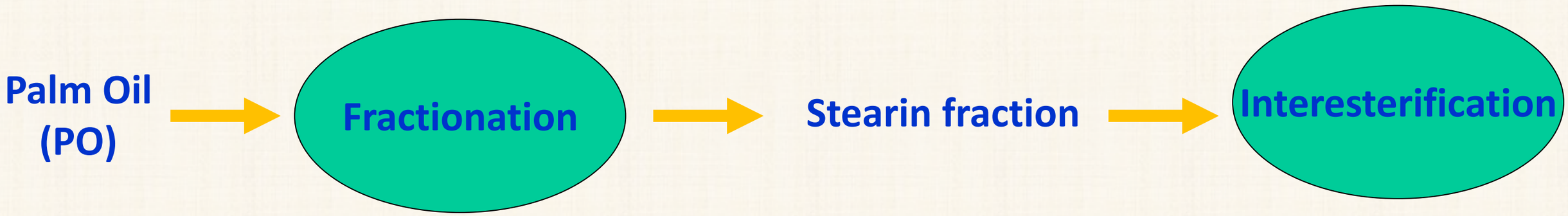
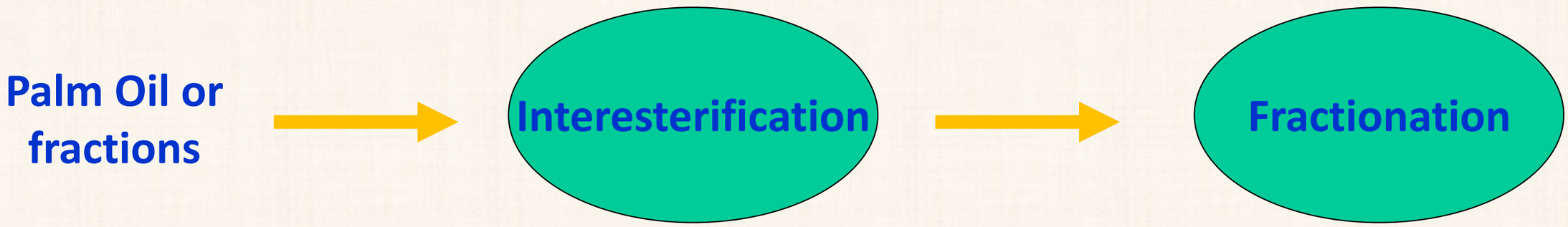
Classical way



This research: How can interesterification improve fractionation?



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Results

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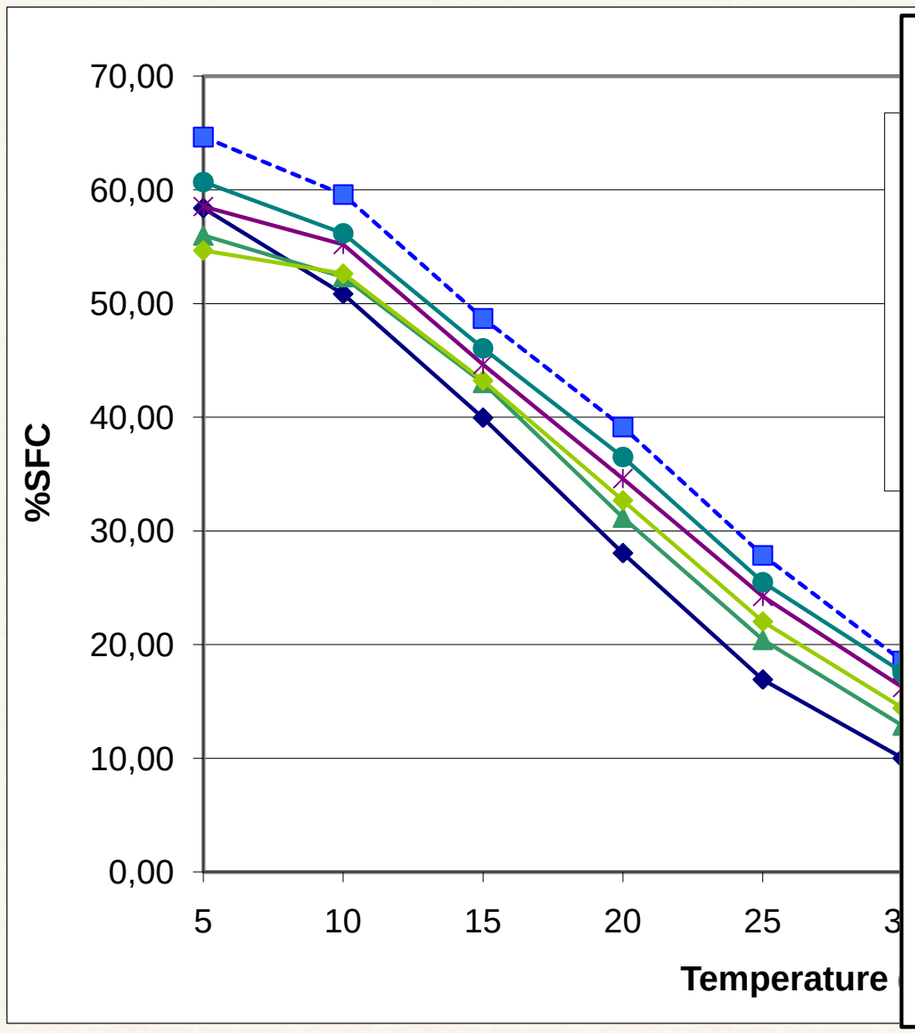
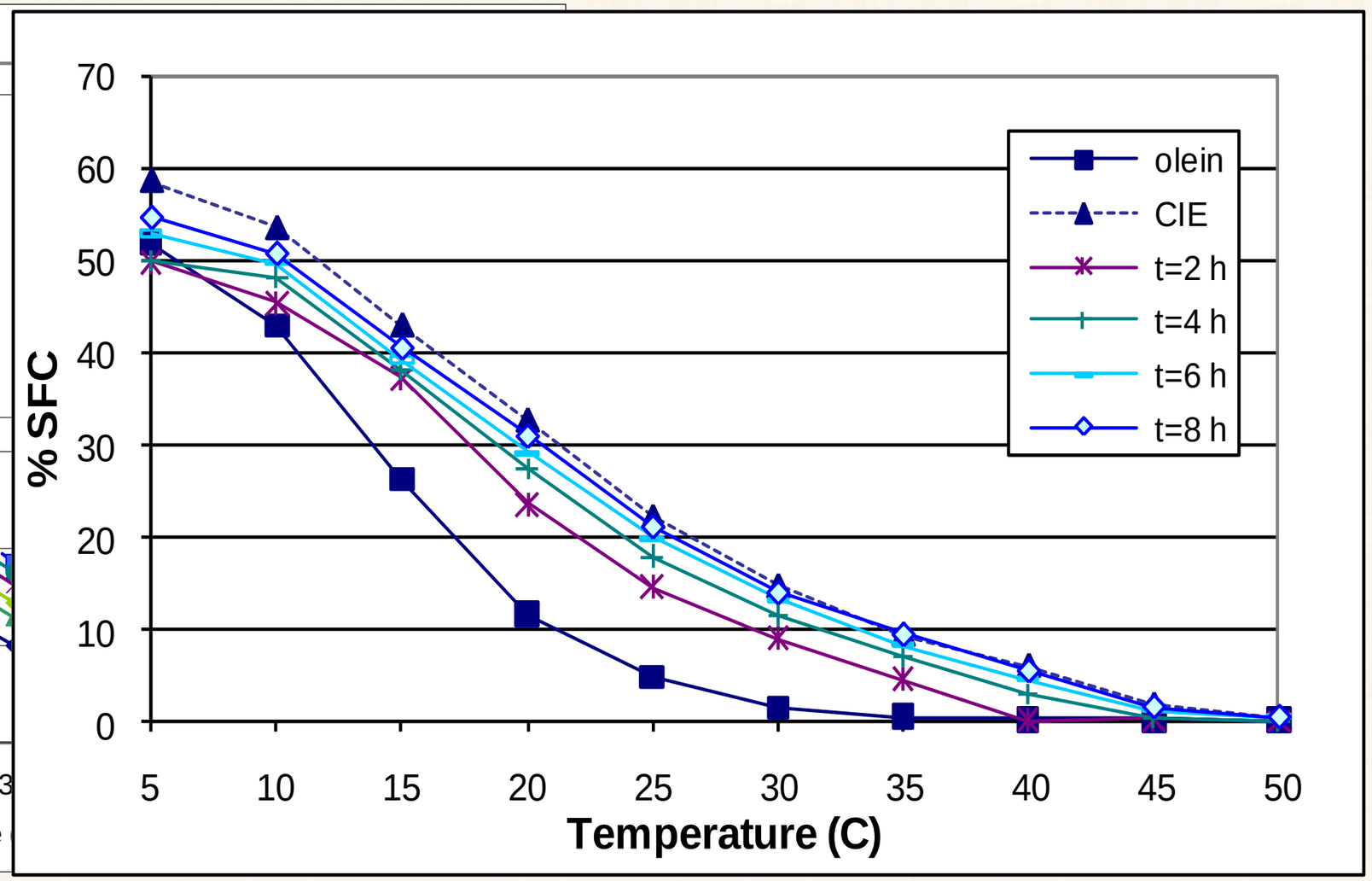
SFC as a function of temperature during batch EIE from 2h to 8h

Palm oil



Palm olein



Interesterification hardens the oil

SFC of interesterified oil increases with time

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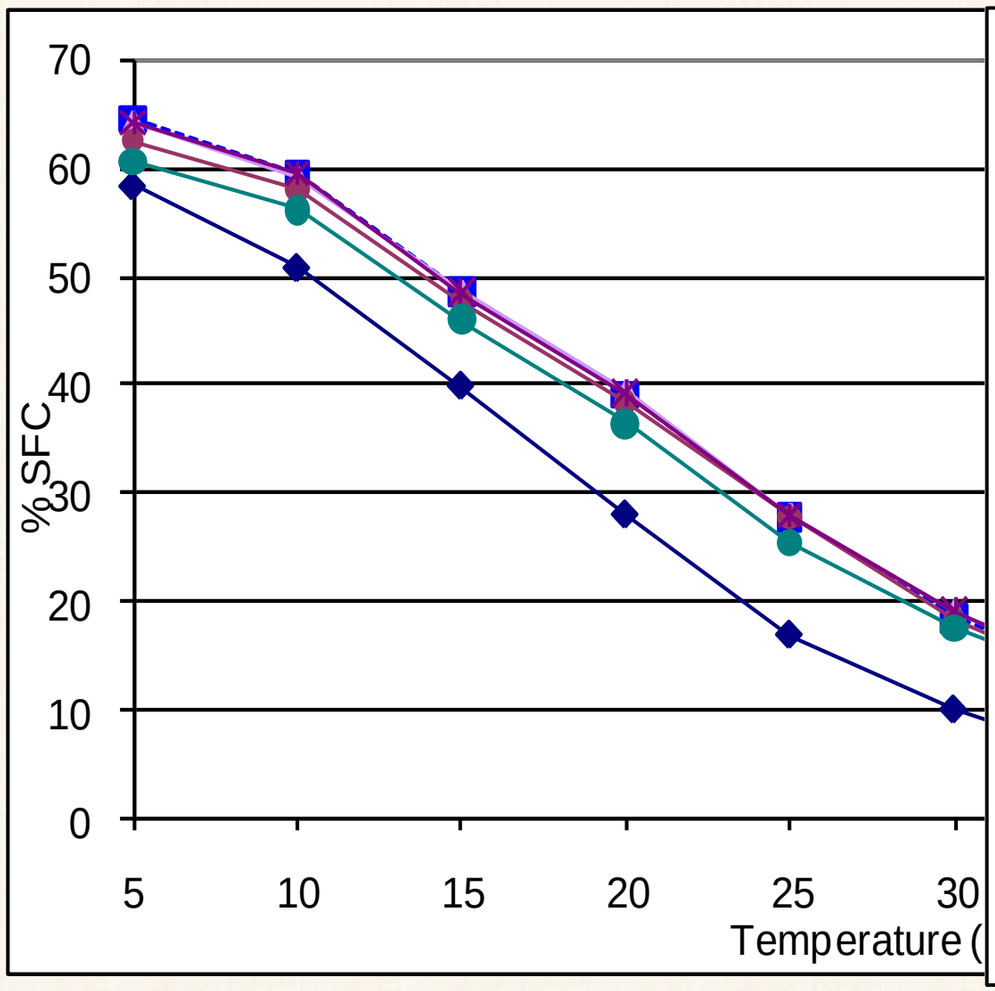
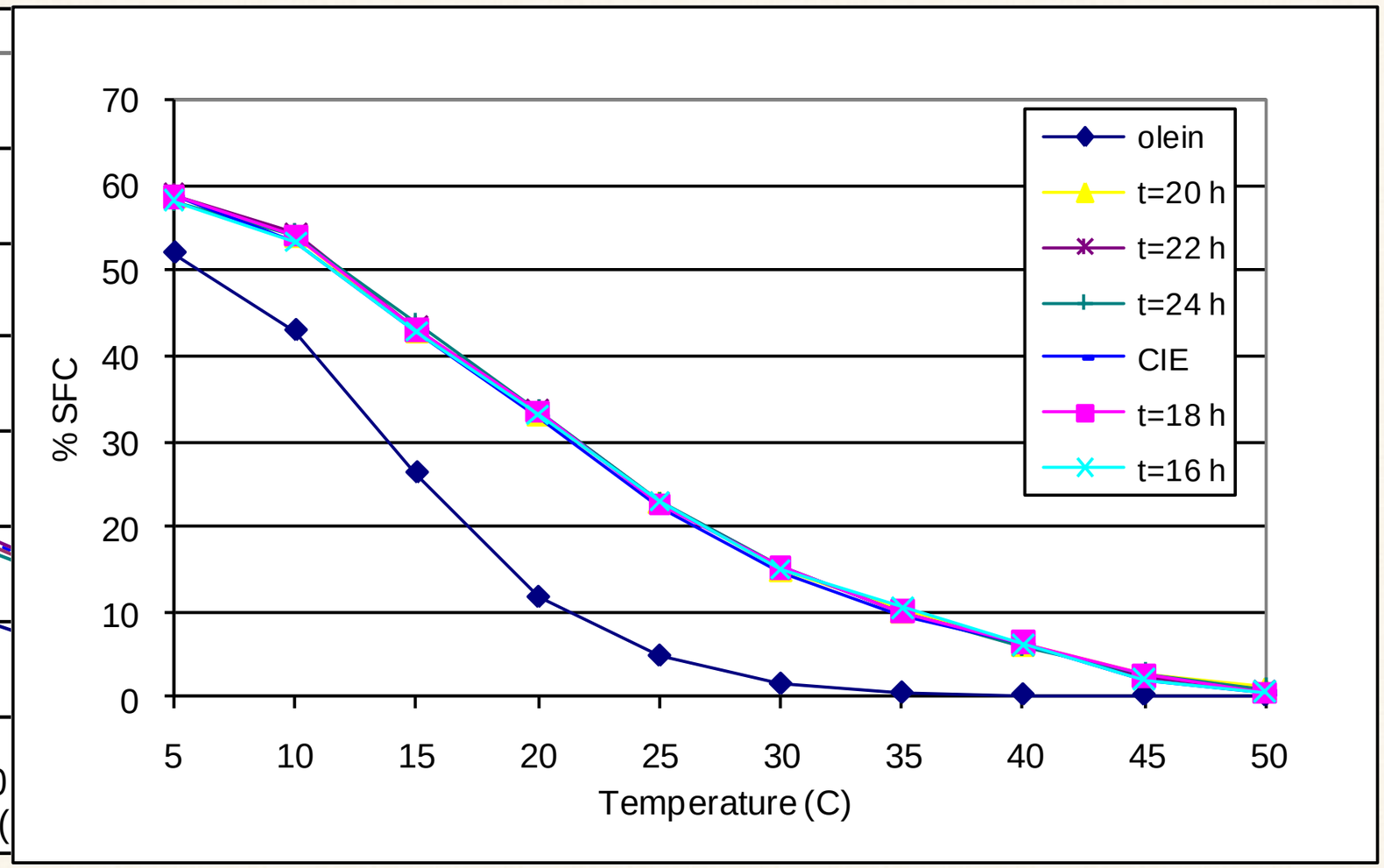
SFC as a function of temperature during batch EIE

Palm oil (8h, 22h, 28h & 30h)



Palm olein (16h to 24h)

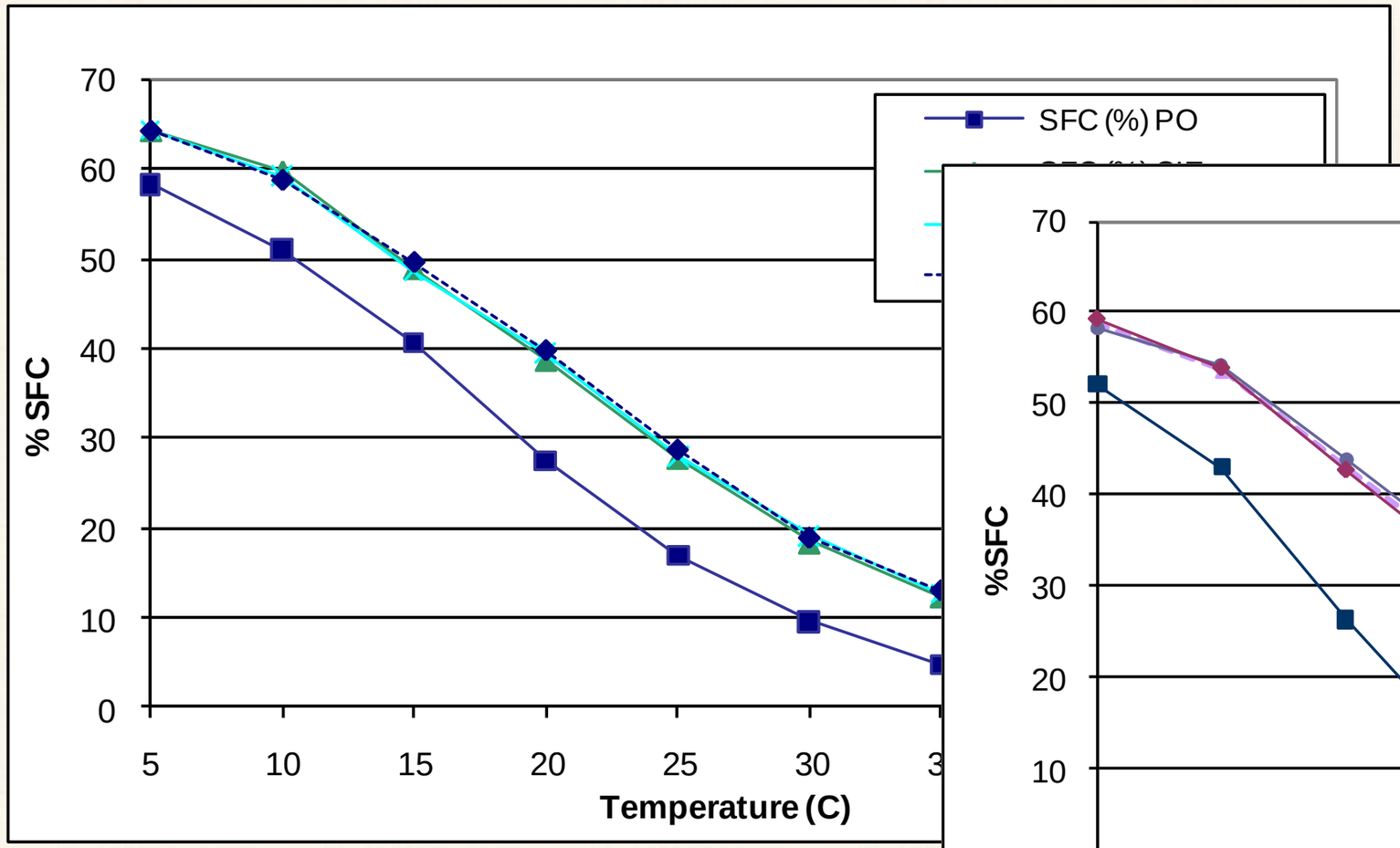


CIE: reference

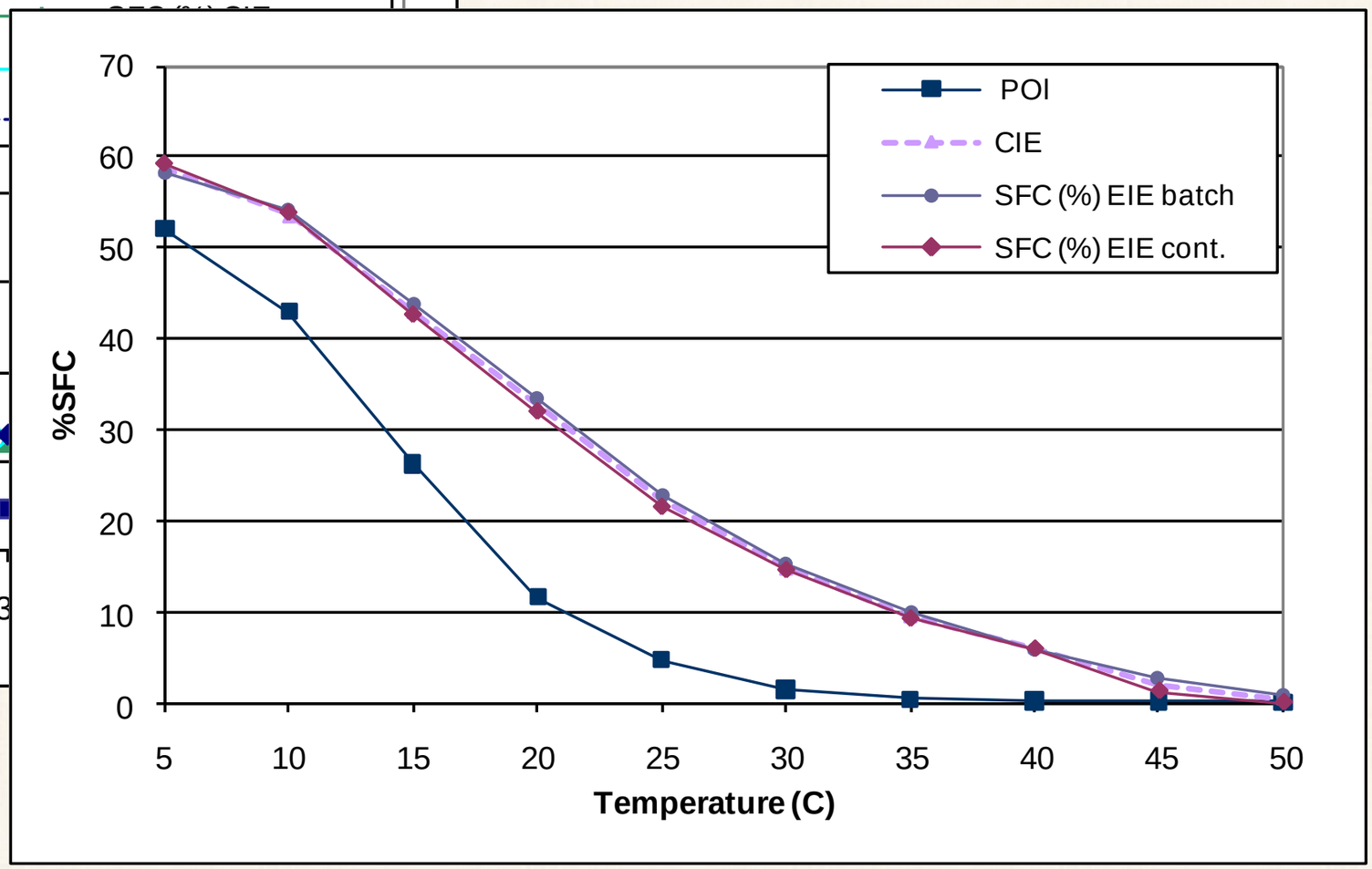
Reaching randomization: Palm oil (after ~22h), Palm olein (after ~16h)

SFC of palm oil/palm olein, CIE and EIE (batch and continuous)

Palm oil



Palm olein



No matter which process (batch EIE, continuous EIE), both lead to a randomization(CIE)

Comparison of dry fractionation of interesterified palm oil and native palm oil

Palm oil after fractionation

	Rep 1	Rep 2
	Olein	Olein
IV	61.10	64.70
CP (°C)	3.1	0.9
SSS	0.00	0.00

IV, CP → Quality of an olein

Using IE feedstock does not increase the quality of olein

EIE palm oil after fractionation

	Press filtration 1			Press filtration 2		
	Olein fill	Olein SQ 6bar	Olein SQ 15bar	Olein fill	Olein SQ 6bar	Olein SQ 15bar
IV	61.5	62.4	62.3	64.1	65.2	65.2
CP (°C)	7.7	7.8	7.4	5.5	4.8	4.8
SSS	0.44	0.11	0.11	0.22	0.22	0.11

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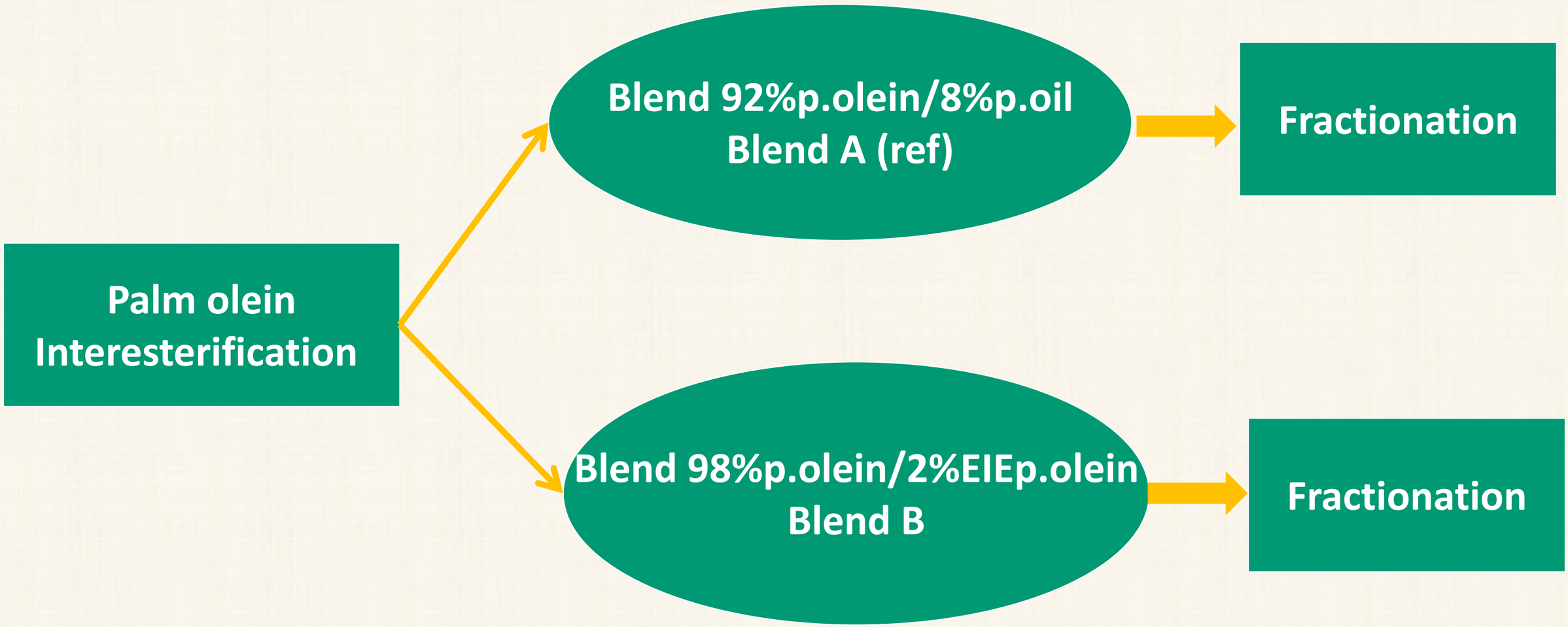
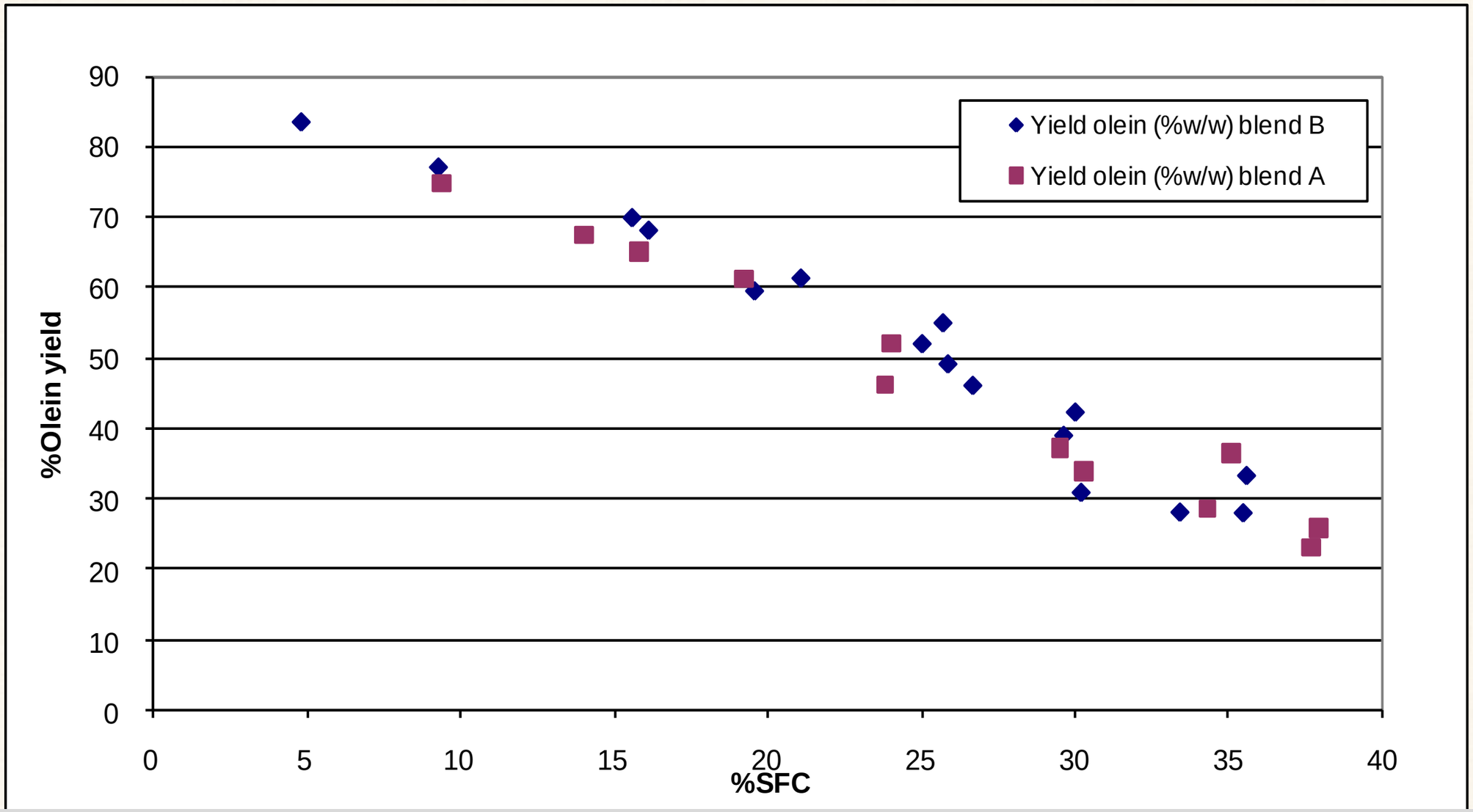
Interesterified palm olein as a seeding agent during the fractionation of palm olein?



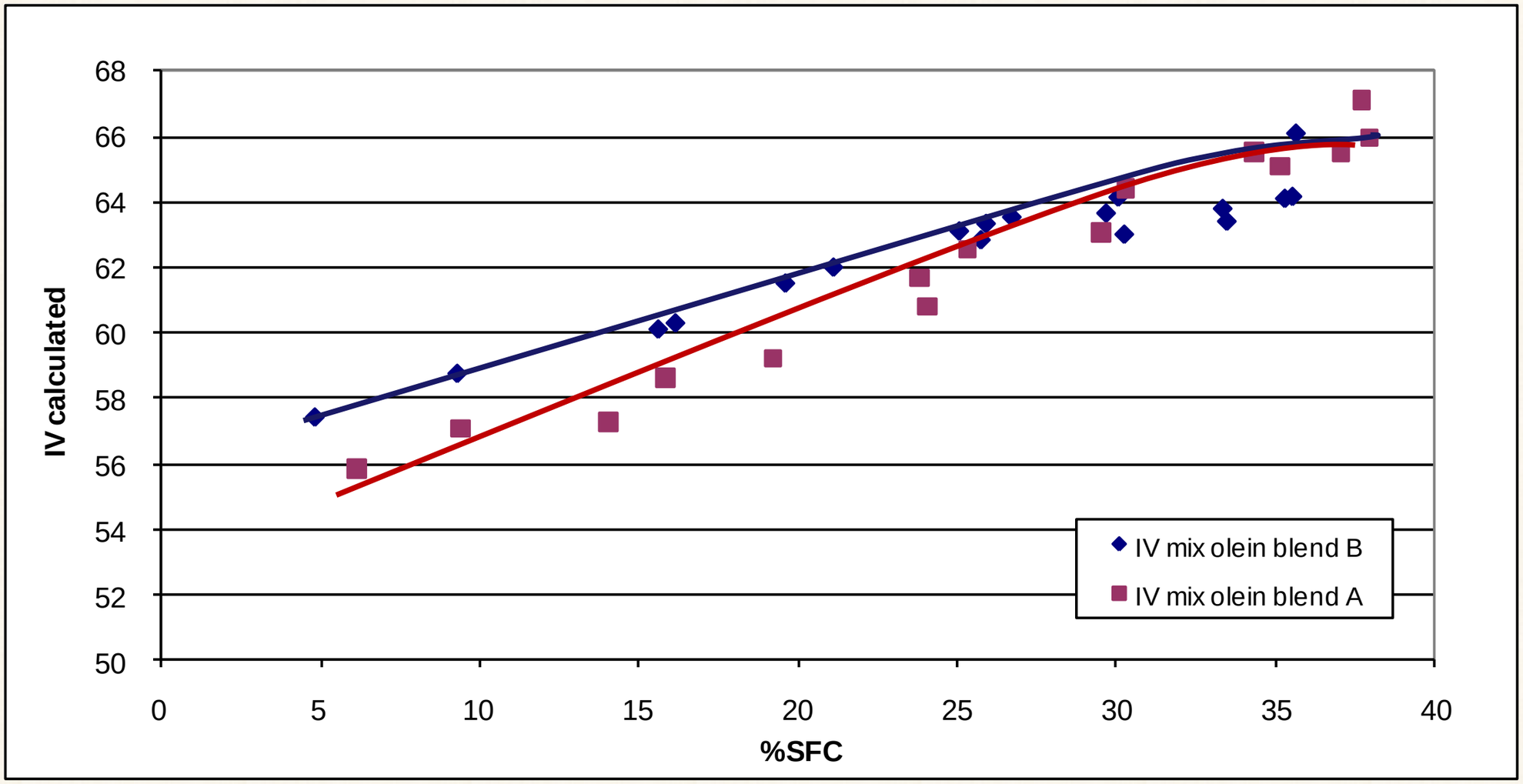
Comparison between the fractionation of two blends

Olein yield



At the high SFC values, not real difference between yields of 2 blends

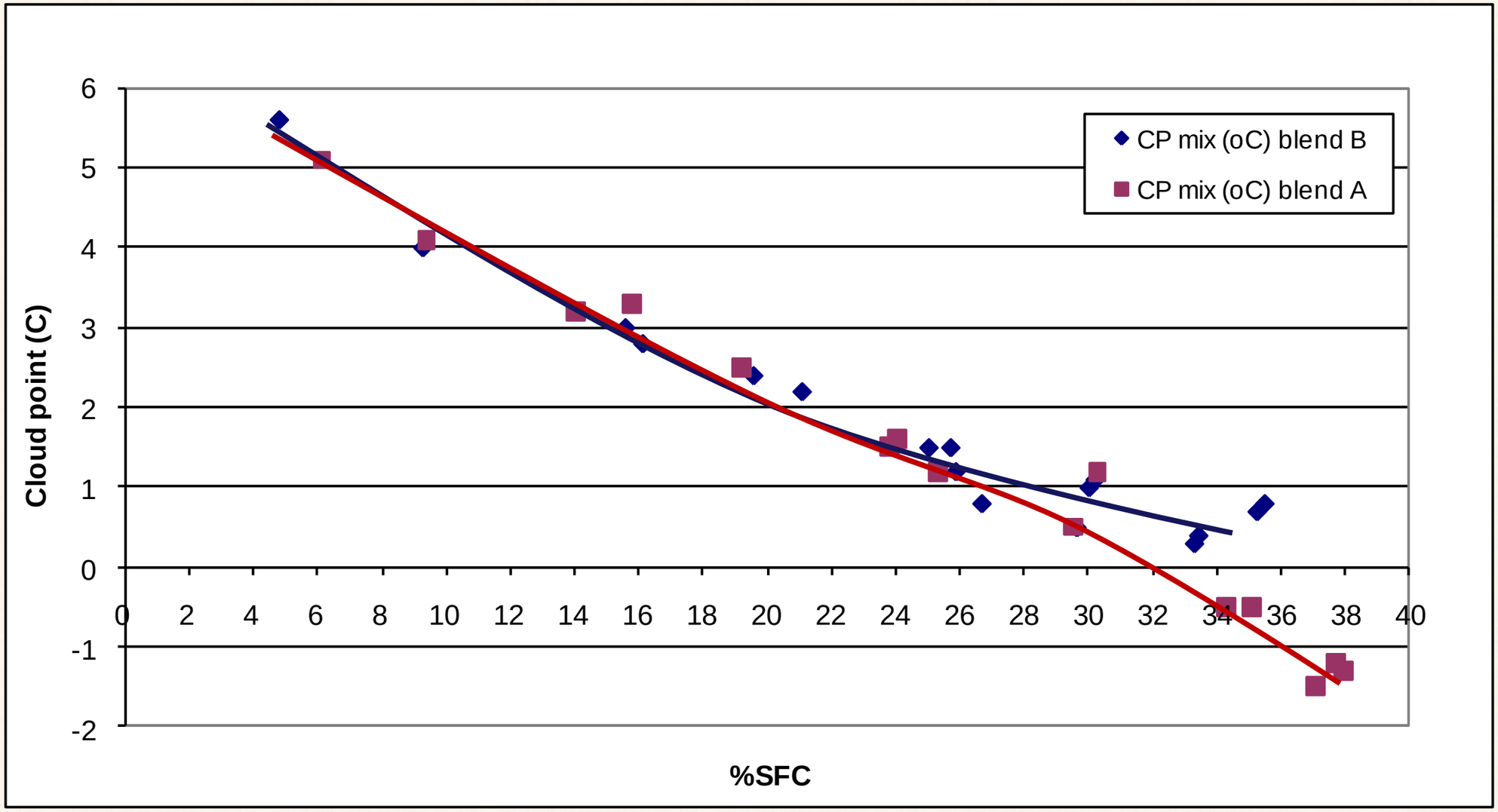
Iodine value



IV increased over the whole range of SFC

Below 25% SFC, IV of blend B is higher than blend A

Cloud point



Above 30% SFC, CP of blend B remains more or less constant

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TAG composition of the olein fractions from blend A and B at SFC between 25% and 35%

	Blend A			Blend B						
	5VF3	3VF1	4VF1	4VF1	4VF2	5VF1	6VF1	6VF2	7VF1	7VF2
%SFC	25.00	34.00	35.00	25.88	30.03	30.22	26.69	29.65	33.44	35.26
%UUU	8.62	10.58	8.08	9.06	9.34	9.27	9.23	9.40	9.50	9.42
%SUU	54.78	62.69	62.25	54.79	56.34	55.95	55.37	56.80	57.54	56.71
%SUS	36.31	26.50	29.65	35.46	33.68	34.08	34.74	33.20	32.38	33.32
%SSS	0.29	0.22	0.02	0.69	0.64	0.69	0.66	0.60	0.58	0.55

→ **Adding interesterified palm olein did not improve the quality of the palm olein fraction**

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Why interesterification does not help the fractionation

Food Technology and Engineering at the Department of Food Safety and Food Quality
Prof. Koen Dewettinck

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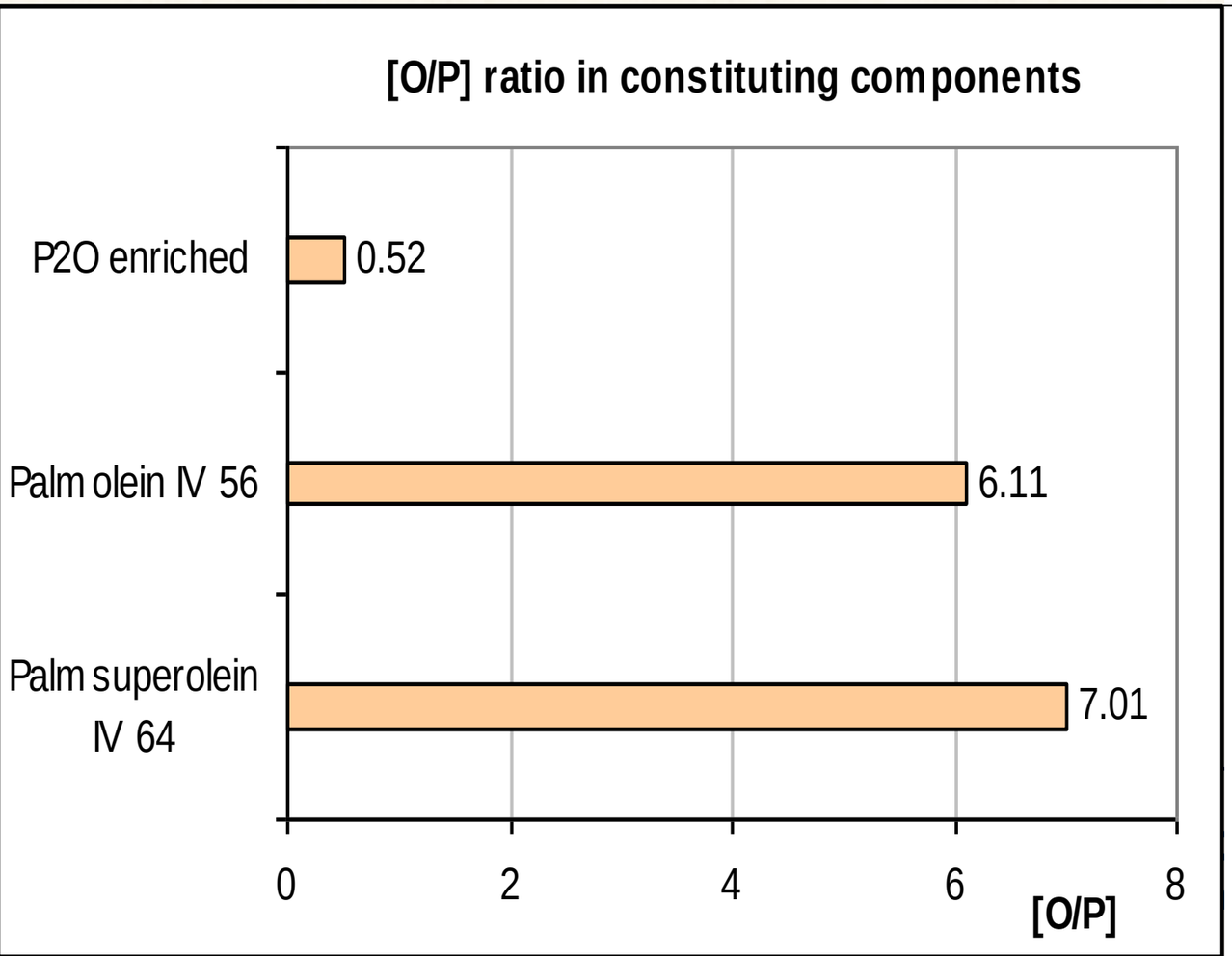
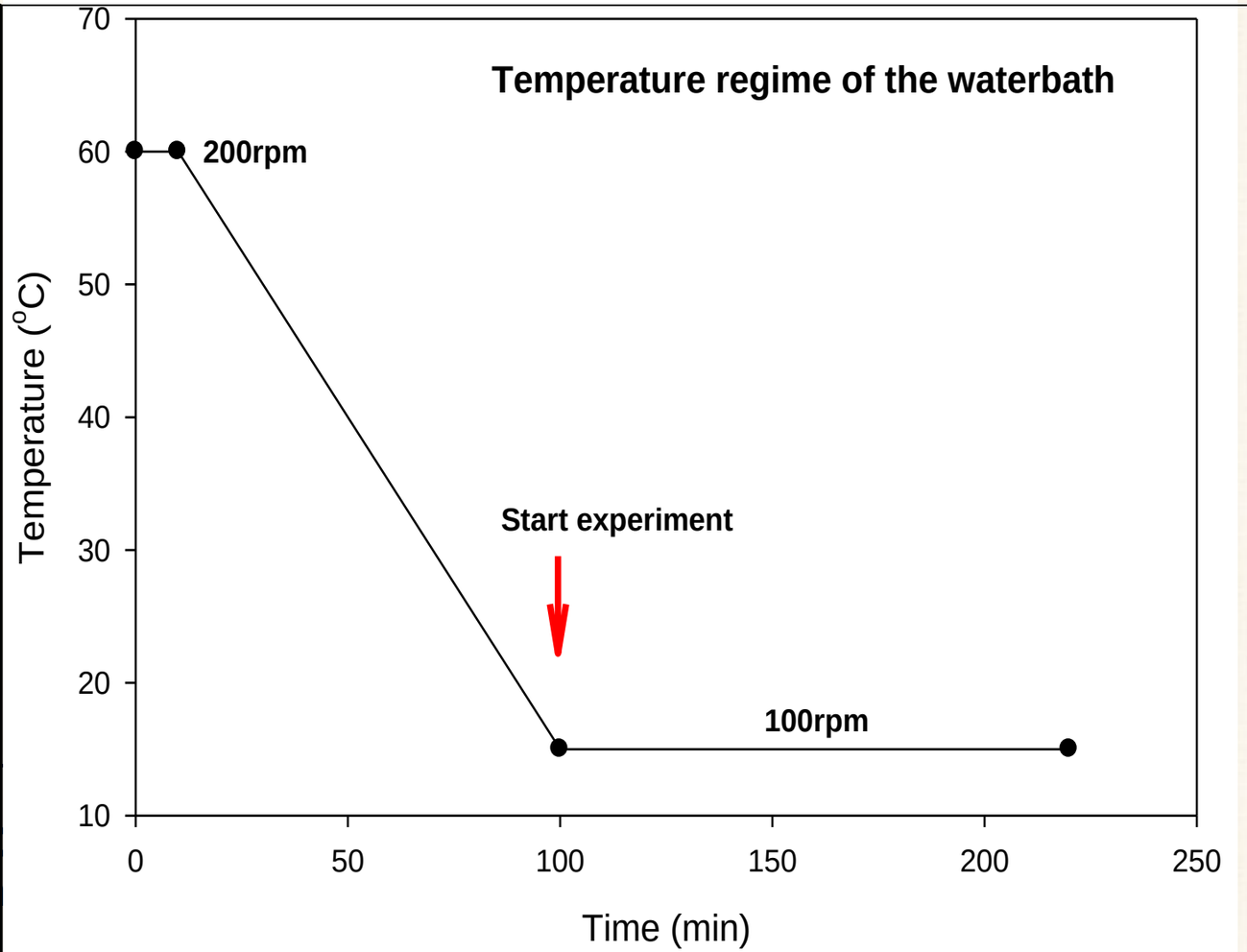
Interesterification:

The ratio of POP/OPP in IE palm olein is significantly changed

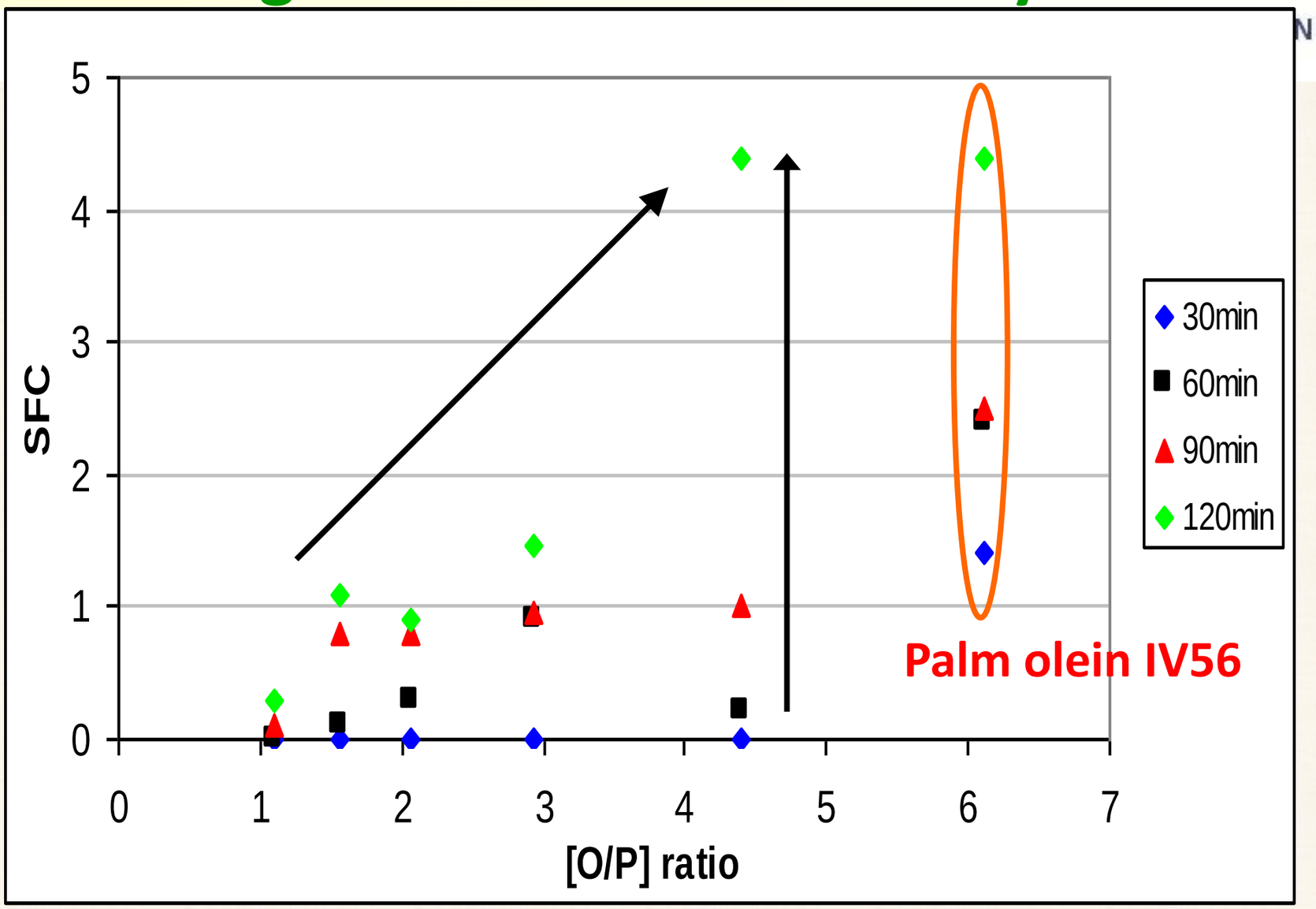
Effect of the POP/OPP ratio

- An enriched fraction of 55% P_2O (POP&OPP) was produced
- Enriched P_2O fraction, palm olein, palm superolein → making blends with different POP/OPP ratios → crystallization
- Assumption: POP/OPP ≈ O/P sn2





SFC profiles during lab scale isothermal crystallization at 15°C



Lab scale crystallization

- Higher O/P ratio → higher SFC → better crystallization
- Interesterification: O/P ratio decreased → crystallization was worse

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