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Synthetic esters: combining food safety and high performance

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Ambika Satish – Siegfried Lucazeau

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Agenda

1. The needs of food industry: a double challenge
2. Standards for food contact approval
3. Capabilities of synthetic esters
4. Conclusion

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The needs of food industry: a double challenge

Lubrication in food industry

Food industry

- Meat processing
- Beverage production
- Bakeries
- Dairy production
- Cooked food
- …

needs lubrication…
as any other industry

Lubrication in food industry

A variety of equipment, that needs oils and greases

- Conveyor belts
- Chains
- Pumps
- Mixers, slicers, wrappers and packers
- Compressors
- Vacuum pumps
- Hydraulic systems

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Double challenge: Performance

Some chains may operate in high temperature conditions (bakery ovens : up to 300°C)

Deep freezing conditions may be found (up to -50°C)

Presence of large amounts of steam, water and contaminants (dusts, sugars, chemicals…)

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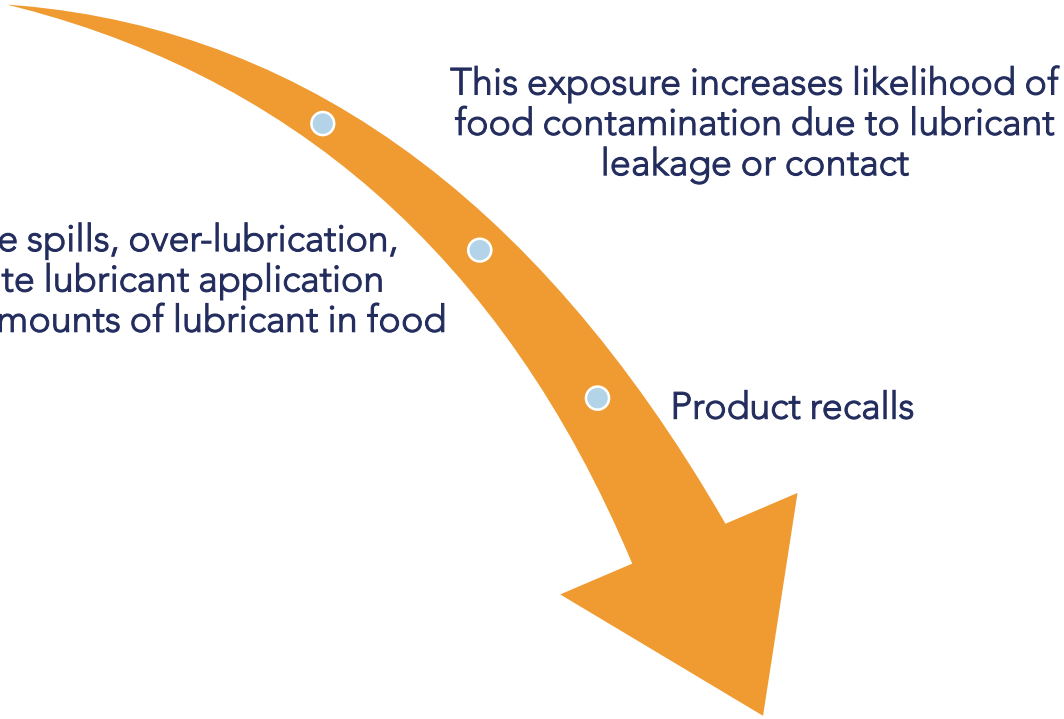
Double challenge: food safety

Manufacturing processes expose food products to equipment that requires proper lubrication



This exposure increases likelihood of food contamination due to lubricant leakage or contact

Unavoidable spills, over-lubrication, inappropriate lubricant application introduce amounts of lubricant in food

Product recalls

Liability
Impact on company image
Insurance costs

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Standards for food contact approval

Management & Process

ISO 21469

- certification of manufacturing process of food grade lubricant (hygiene requirements)

HACCP (Hazard Analysis Critical Control Point)

- method for assessing, monitoring and controlling food contamination risk
- used in ISO 22000 (food safety management system)

Safer components

In spite of risk management and good industrial practises, food contamination remains unavoidable:

- Over lubrication
- Inadequate lubricant application system
- Maintenance operations
- Leakage
- Mechanical failure
- Wrong equipment design…

✓ Hence the need for safer components in lubricating oils and greases

US Department of Agriculture

USDA NSF InS

Up until 1998, the U.S. Department of Agriculture (USDA) issued approvals for lubricants used in meat and poultry processing

Approval based on positive list of substances issued by the Food and Drug Administration (FDA) in accordance with CFR 21-178.3570

Sections referenced in 178.3570 list ingredients that are generally recognized as safe (GRAS) for use in food

Lubricant formulations may contain synthetic oils, edible oils such as soybean, cottonseed and corn oil, or white mineral oil

Must comply with purity requirements, including color and UV absorbance limits

The National Sanitation Foundation (NSF) took over registration of lubricants based on USDA procedure – InS, UK also offers registration

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Certification grades

H1

- Certification for approved lubricants for incidental food contact

H2

- Certification for approved lubricants for food processing equipment, without food contact

H3

- Certification for soluble oils (cleaners and anti-rust products, removed before equipment use)

3H

- Certification of edible oils to prevent adhesion (release agents)

HT1

- Certification for heat transfer fluids approved for incidental food contact

HT2

- certification for heat transfer fluids without food contact

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Components

HX-1

- Certification of components for H1 certified lubricants

HX-2

- Certification of components for H2 certified lubricants

HX-3

- Certification of components for H3 certified lubricants

HTX-1

- Certification of components for HT1 certified lubricants

HTX-2

- Certification of components for HT2 certified lubricants

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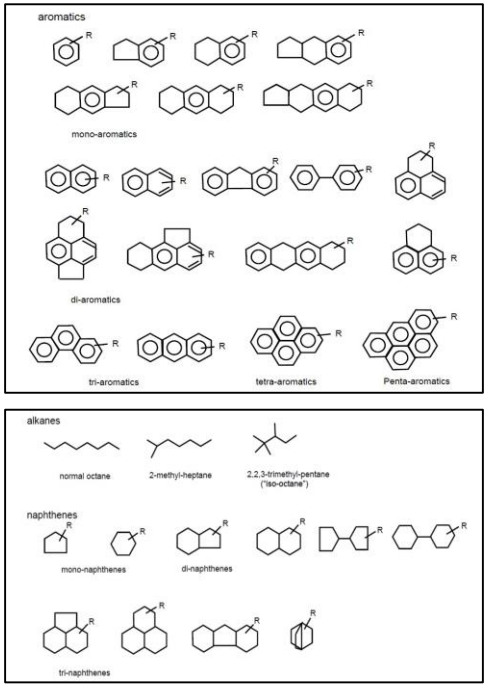
Mineral Oil Hydrocarbons

- ✓ Petroleum derived compounds may contain:

MOAH: aromatic compounds, suspected of carcinogenicity and genotoxicity

MOSH: saturated compounds, suspected of bioaccumulation and toxicity to liver



- ✓ Concern primarily for products intended for direct contact (wrapping)

- ✓ « As Low As Reasonably Achievable (ALARA) » precautionary principle may still be used on the market for H1 lubricants

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Capabilities of synthetic esters

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Possible base fluids

NSF and InS services provide a list of HX-1 components for lubrication

✓ Base fluids:

White oils, PAO, Esters, PAG, Silicones, PIB, alkylated naphthalenes

✓ Thickeners for greases:

Calcium, Calcium complex, Calcium sulfonate, Aluminum complex, Silica, Clay, Polyurea, PTFE

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Performance?

Early H1 certified products suffered from a bad reputation with regards to their technical performance

The growing use of synthetic lubricants that combine performance and food safety, however, is changing the picture

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Benchmarking

	White oil	PAO	Synthetic Ester	PAG	Alklylated Naphthalene
KV40 *mm²/s*	30	31	28	26.2	36
KV100 *mm²/s*	-	8	5.7	5.2	5.6
VI	-	135	160	132	65
Pour Point *°C*	-6	-63	-38	-48	-33
Flash Point *°C*	200	245	265	242	236
Resistance to oxidation	o	+	+++	++	+
Friction modification	o	+	++	++	o
Volatility NOACK *% mass*	-	6.8	2.3	-	12

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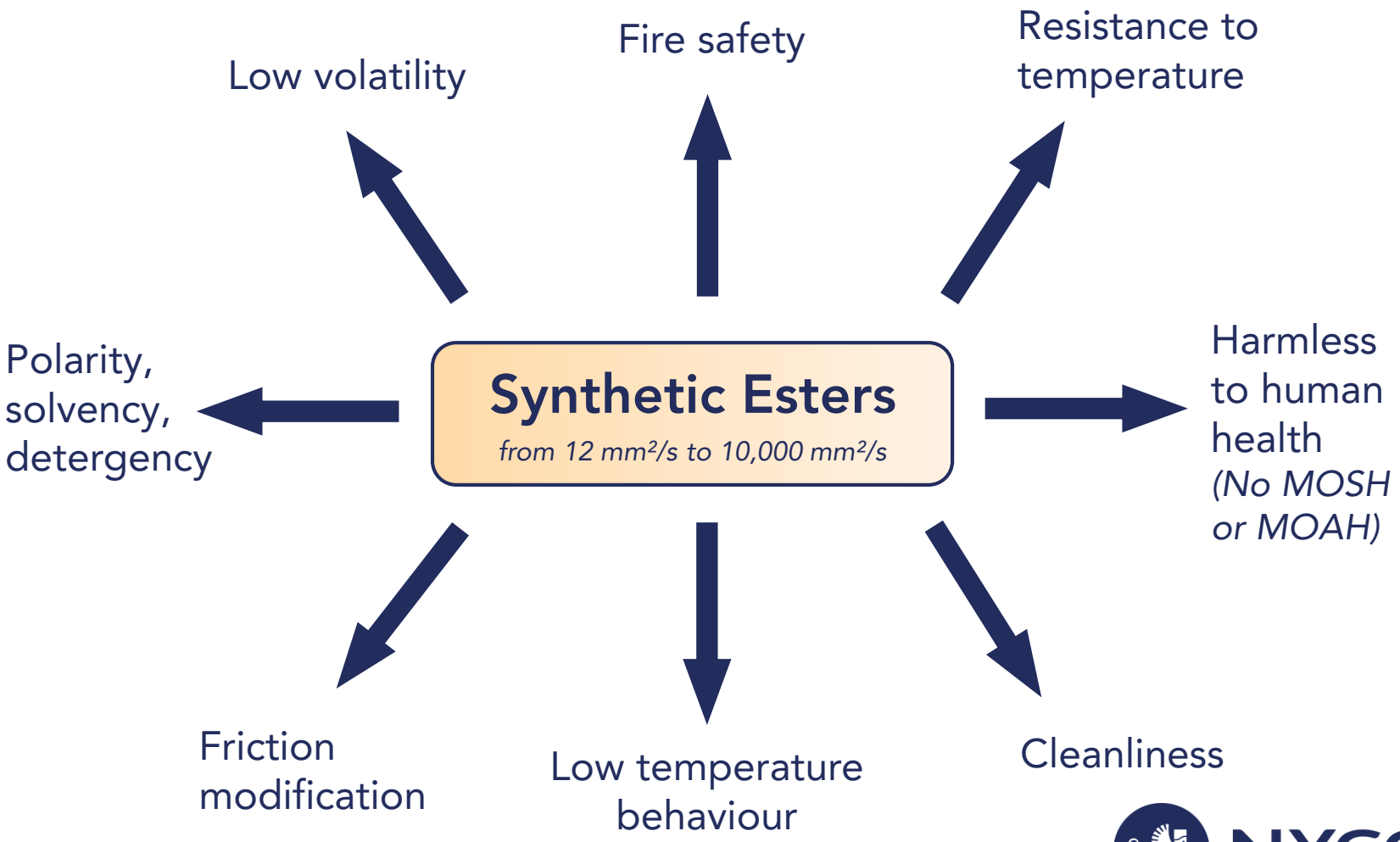
Performance features of esters



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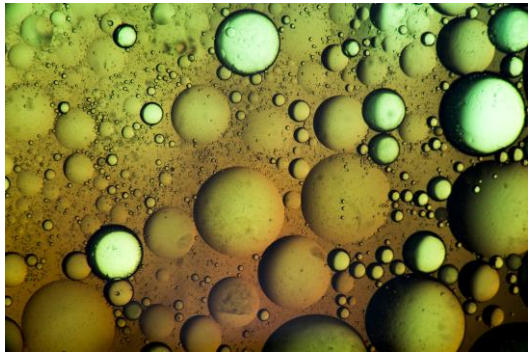
Polarity agents

In low polarity base fluids (PAO), esters provide:

- ✓ *Added solvency*
- ✓ *Seal swell compensation*
- ✓ *Added detergency and cleanliness*
- ✓ *Improved resistance to oxidation*



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High temperature H1 chain oil

PROPERTIES	UNIT	TYPICAL RESULT	TEST METHOD
Kinematic viscosity at 40°C	mm^2/s	219	ISO 3104
Evaporation, 6 h – 200°C	% mass	0.4	ASTM D972
Steel corrosion	-	Pass	ISO 7120A
Copper corrosion	-	1b	ISO 2160
4 ball Wear Scar 1 h – 392 N	mm	0.42	ASTM D4172
Flash point COC	°C	296	ISO 2592

GFC Lu-27-A-13, Micro-Coking Test, 230-280°C	
Deposit temperature	>280
Average merit	10

GFC Lu-27-A-13, Micro-Coking Test, 250-300°C	
Deposit temperature	<250
Average merit	8,17

- ✓ Synthetic ester based high temperature chain oils deliver outstanding performance in volatility, longevity and cleanliness

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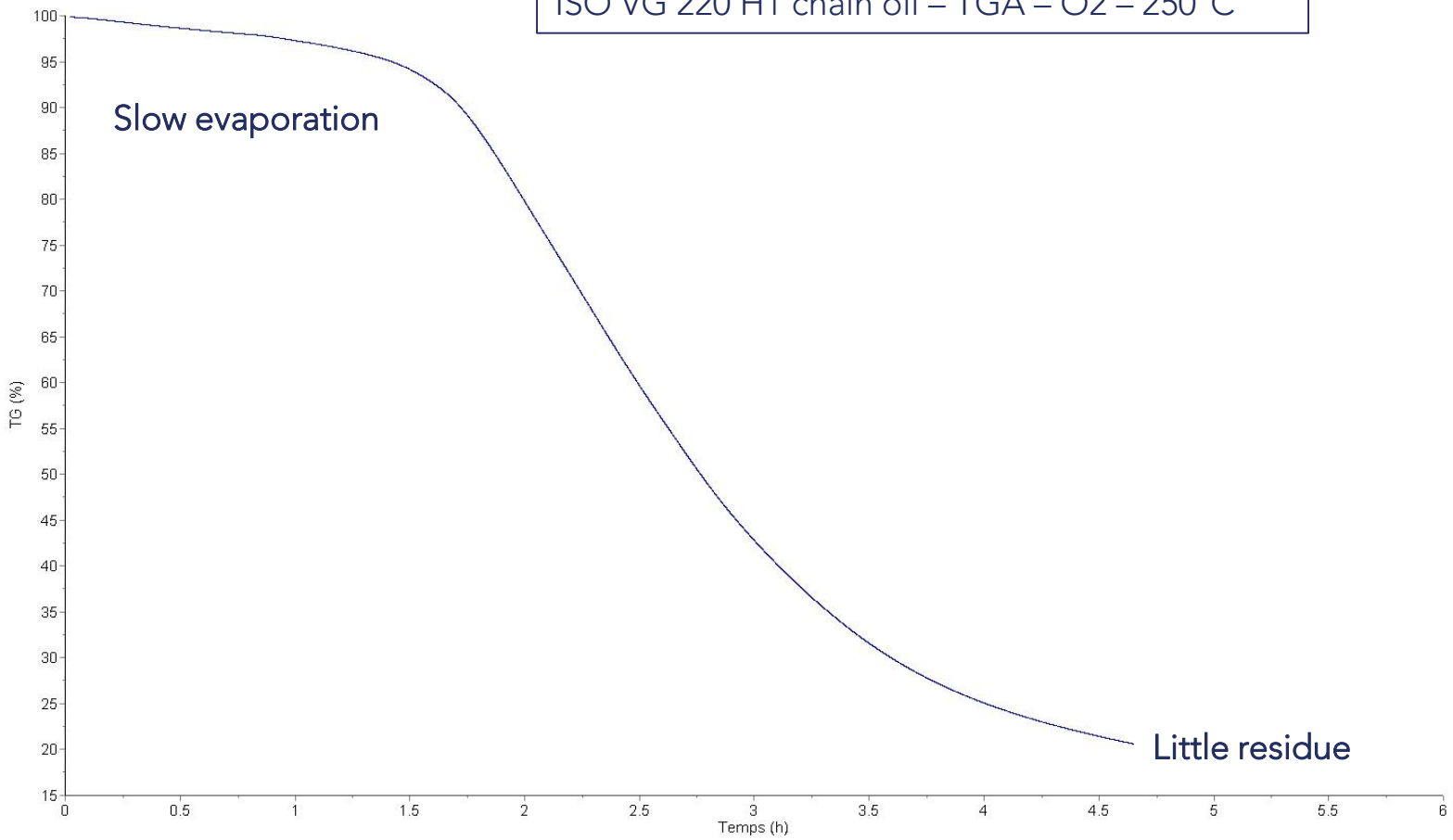
High Temperature H1 chain oil

ISO VG 220 H1 chain oil – TGA – O2 – 250°C



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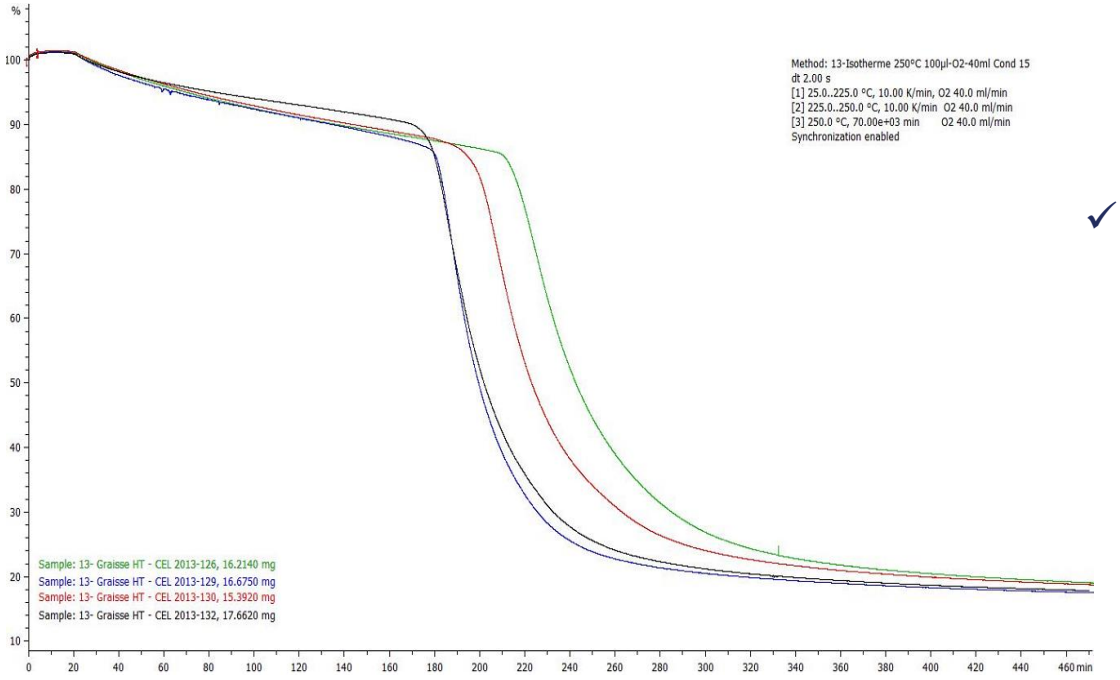
High temperature H1 grease

Clay grease based on high viscosity HX-1 ester

PROPERTIES	UNIT	RESULT	TEST METHOD
P60	1/10 mm	294	ASTM D217
Dropping Point	°C	>300	ASTM D566
Oil separation – 30 h, 200°C	% m	5.6	ASTM D6184
Evaporation – 22 h, 200°C	% m	2.1	ASTM D972



- ✓ Synthetic ester based greases show outstanding resistance to high temperature

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Conclusion

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Dual competence

- ✓ Lubrication requirements and food contamination risk both must be dealt with in food industry
- ✓ Contamination risk management is composed of process management/good industrial practises AND use of safe lubricants
- ✓ Saturated, synthetic esters show a unique performance profile as base fluids or additives for H1 lubricants
- ✓ *Combining food safety and lubrication performance: dual competence of esters for a double challenge*

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Thank you!