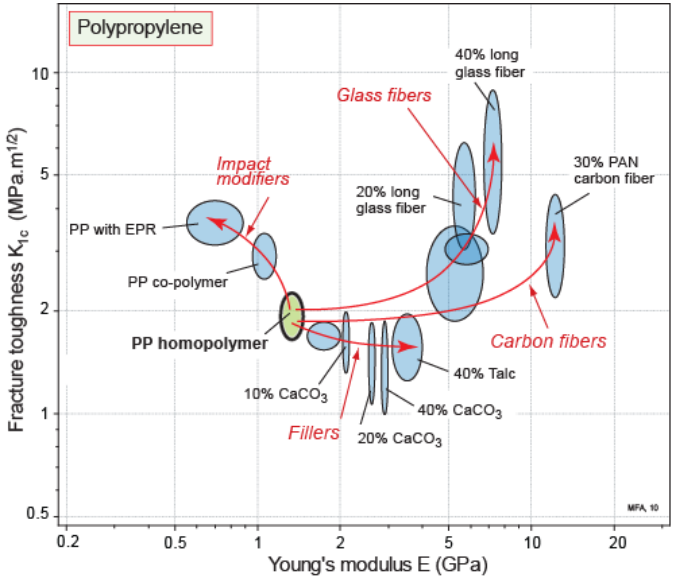
جامعة الإمارات العربية المتحدة
United Arab Emirates University
UAEU



GRANTA CES 2019 EDUPACK

PhD student: Abdulla Almomani (202090026), MECH736 Fall 2020

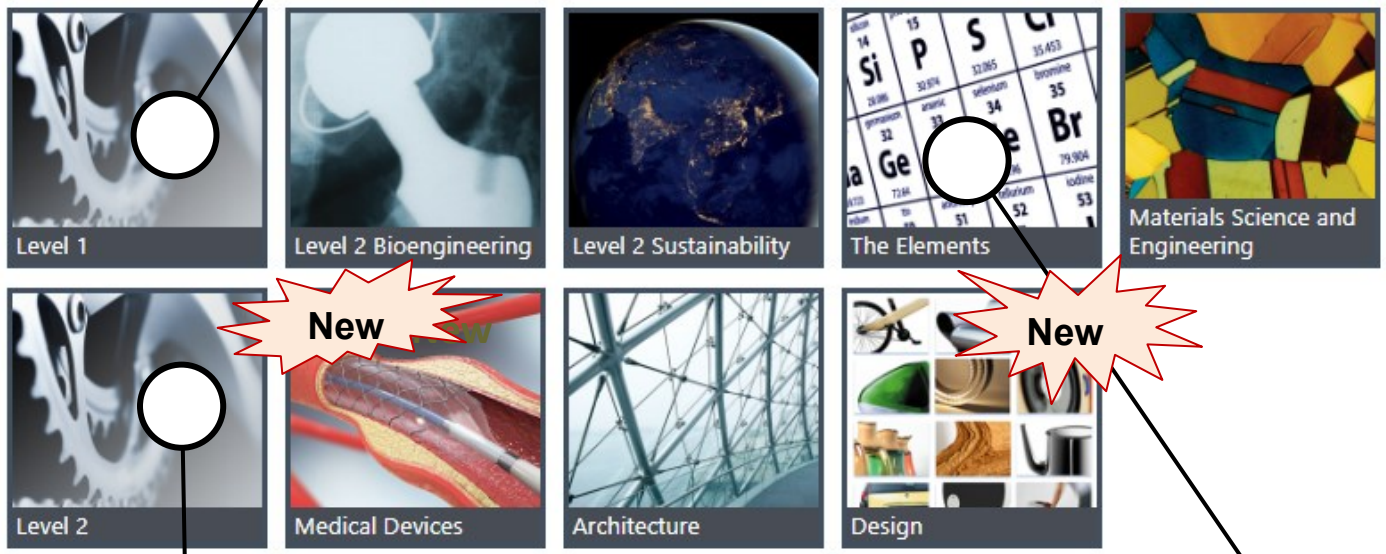
PERFORMANCE CHARTS - CES EDUPACK

Databases

Level 1, general

- Schools, **1st year** college
- **69** materials, **74** processes

Introductory



New

New

Level 3, general

- **3rd-4th year**, **masters** and **research**
- **4169** materials, **247** processes

Advanced

Level 2, general

- **1st-3rd year** students of Engineering, Materials Science and Design
- **100** materials, **116** processes

The Elements Database

- Schools-University students
- **149** records, periodic table

UAEU

Design requirements:

expressed as

Constraints *and*

Objectives

Data:

Material attributes

Process attributes

Documentation

Able to be molded

Water and UV resistant

Stiff enough

Strong enough

As cheap as possible

(As light as possible)

Comparison engine

- **Screening**
- **Ranking**
- **Documentation**

Density

Price

Modulus

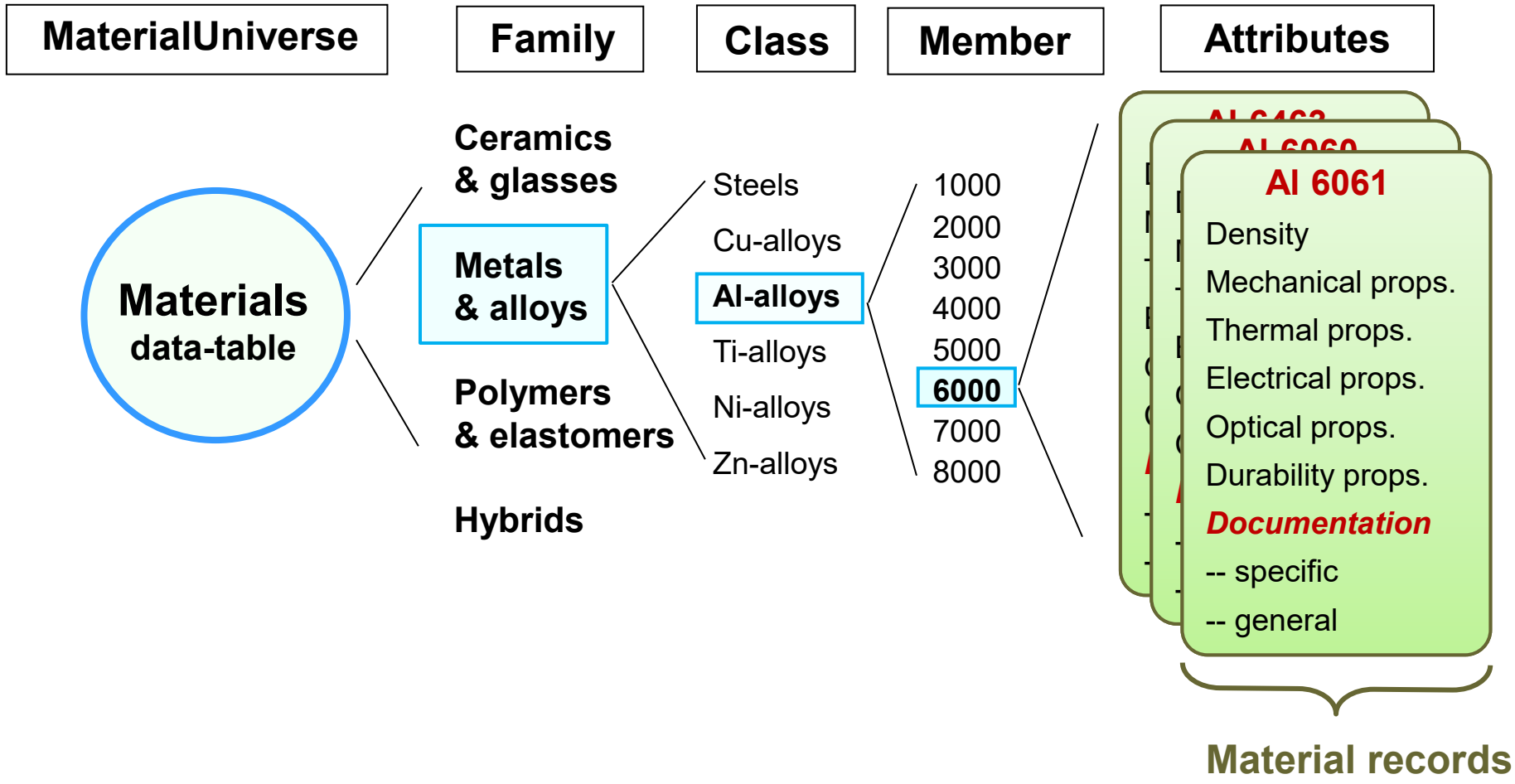
Strength

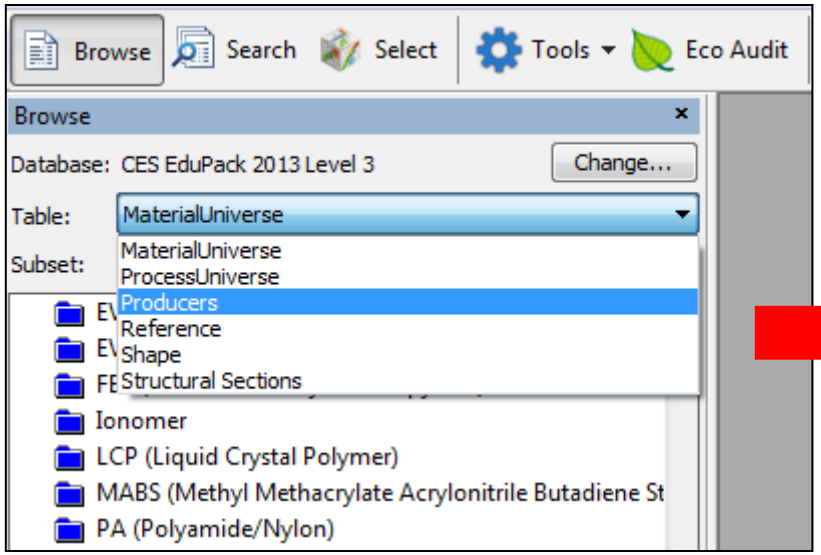
Durability

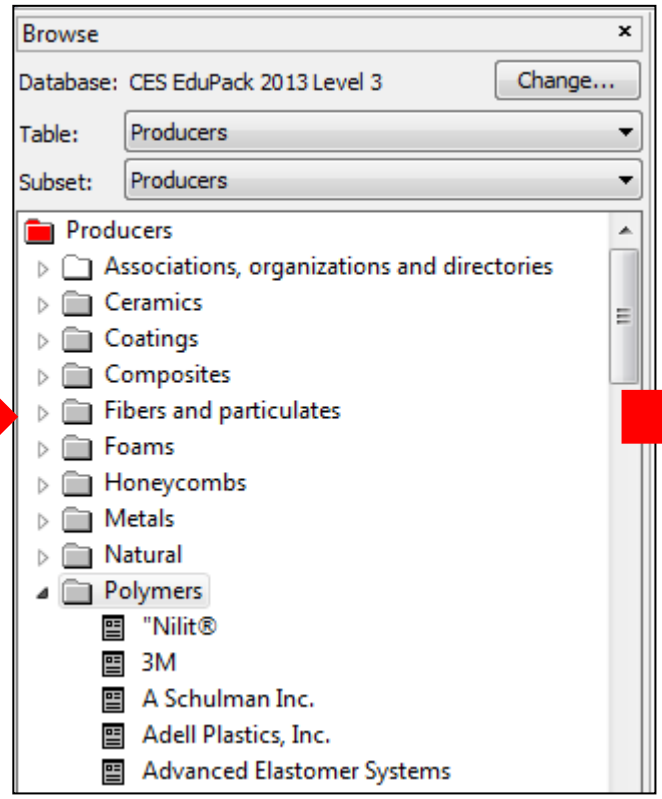
Process compatibility

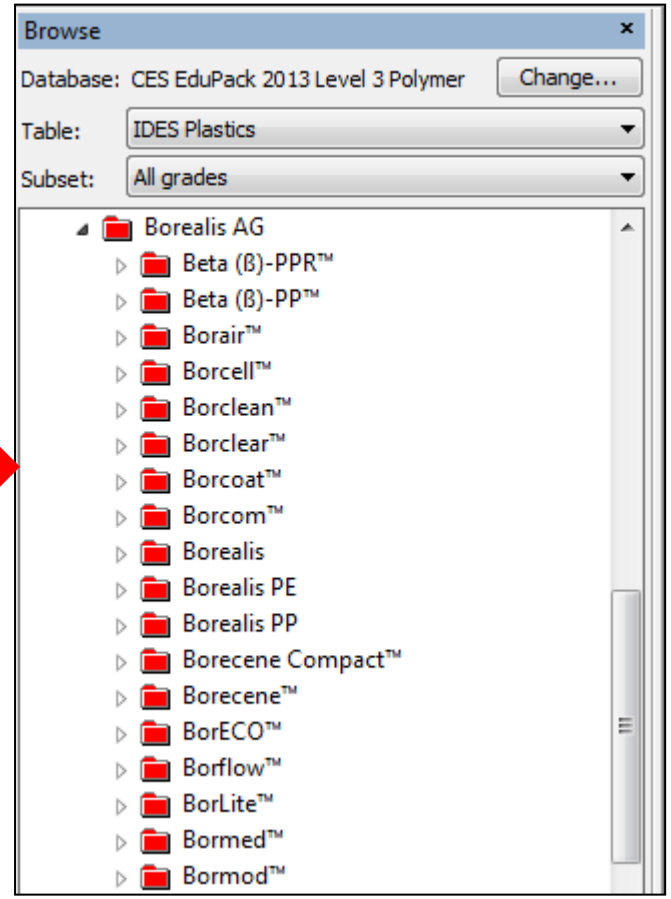
More…….

Final selection


MaterialUniverse
Family
Class
Member
Attributes
Materials
data-table
Ceramics
& glasses
Metals
& alloys
Polymers
& elastomers
Hybrids
Steels
Cu-alloys
Al-alloys
Ti-alloys
Ni-alloys
Zn-alloys
1000
2000
3000
4000
5000
6000
7000
8000
Al 6061
Density
Mechanical props.
Thermal props.
Electrical props.
Optical props.
Durability props.
Documentation
-- specific
-- general
Material records


Browse
Search
Select
Tools
Eco Audit
Browse
Database: CES EduPack 2013 Level 3
Change...
Table:
MaterialUniverse
Subset:
MaterialUniverse
ProcessUniverse
Producers
Reference
Shape
Structural Sections
Ionomer
LCP (Liquid Crystal Polymer)
MABS (Methyl Methacrylate Acrylonitrile Butadiene St
PA (Polyamide/Nylon)


Browse
Database: CES EduPack 2013 Level 3
Change...
Table:
Producers
Subset:
Producers
Associations, organizations and directories
Ceramics
Coatings
Composites
Fibers and particulates
Foams
Honeycombs
Metals
Natural
Polymers
"Nilit®
3M
A Schulman Inc.
Adell Plastics, Inc.
Advanced Elastomer Systems


Browse
Database: CES EduPack 2013 Level 3 Polymer
Change...
Table:
IDES Plastics
Subset:
All grades
Borealis AG
Beta (ß)-PPR™
Beta (ß)-PP™
Borair™
Borcell™
Borclean™
Borclear™
Borcoat™
Borcom™
Borealis
Borealis PE
Borealis PP
Borecene Compact™
Borecene™
BorECO™
Borflow™
BorLite™
Bormed™
Bormod™

Borstar® HE3490-LS (Borealis AG)

Borstar® HE3490-LS (Borealis AG)

Layout: All materials | Show/Hide

General

Product Description

Borstar HE3490-LS is a black, bimodal, high density polyethylene classified as a MRS 10.0 material (PE100) produced by the advanced Borstar technology. Well dispersed carbon black gives outstanding UV resistance. Long term stability is ensured by an optimised stabilisation system.

Borstar HE3490-LS is now registered with the international Traceability coding (Traccoding), under the code R01, in support of ISO12176-4 (2003).

Borstar HE3490-LS is recommended for pressure pipe systems in the applications field of drinking water and natural gas, pressure sewerage, relining, sea outfall and industrial. It is especially designed for the production of larger diameter, thick wall pipe, but can be processed for the whole range of diameters. It also shows excellent resistance to rapid crack propagation and slow crack growth.

Manufacturer / Supplier

Borealis AG

Product Name	Borstar®
Grade	HE3490-LS
Generic Name	Polyethylene, High Density
Material Status	Commercial: Active

Features

Crack Resistance, Good; Recyclable Material; Stability, Good; UV Resistance, Good

Uses

Industrial Applications; Piping

Colors available

Black

Form details

Pellets

Borstar® HE3490-LS (Borealis AG)

Borstar® HE3490-LS (Borealis AG)

Layout: All materials | Show/Hide

Additive

Carbon Black	✓	

Appearance

Colored	✓	

Forms

Granules/Pellets	✓	

Processing Method

Extrusion	✓	

Physical

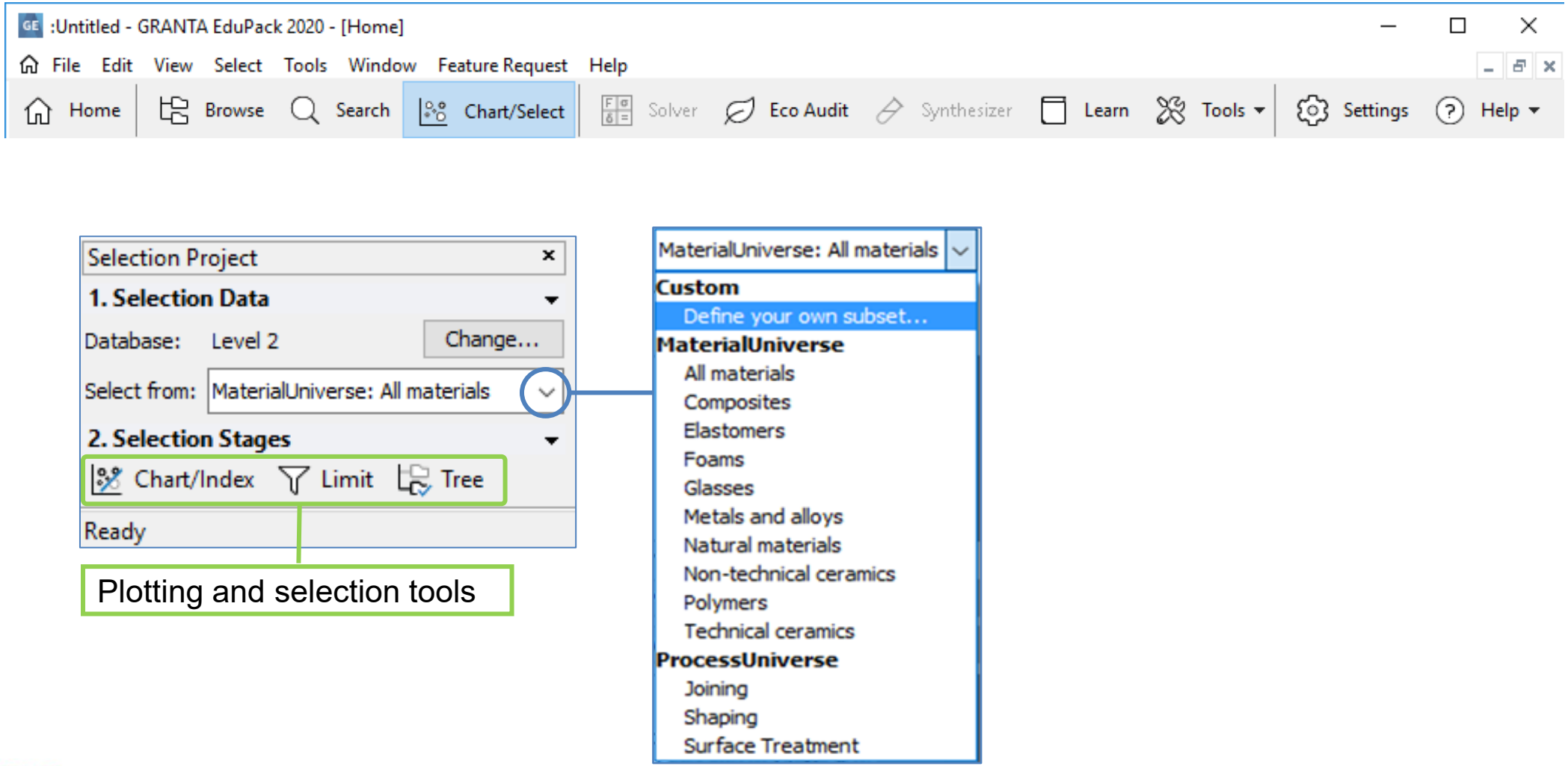
Density (ISO 1183)	0.949	g/cm^3
Conditions: Note=Base resin, ISO 1872-2B		
Env Stress-Cracking Resistance (Cond A) (ASTM D1693	1e4	hr
Conditions: Minimum. Failures=F50; Reagent=10% Igepal		
Melt Mass-Flow Rate (MFR) (ISO 1133)	0.1	g/10 min
Conditions: Condition=190°C/2.16 kg		

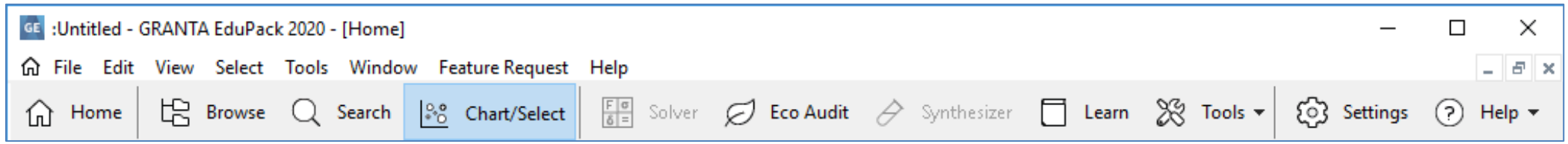
Mechanical

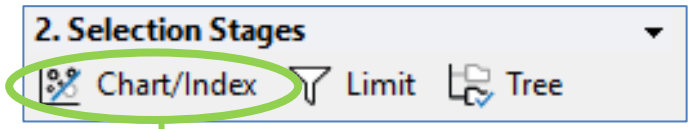
Tensile Stress at Yield (ISO 527-2)	25	MPa
Conditions: Pull Rate=50 mm/min		
Tensile Strain at Break (ISO 527-2)	600	%
Conditions: Minimum.		

Impact

Charpy Notched Impact Strength (0°C) (ISO 179)	16	kJ/m^2


:Untitled - GRANTA EduPack 2020 - [Home]
File Edit View Select Tools Window Feature Request Help
Home Browse Search Chart/Select Solver Eco Audit Synthesizer Learn Tools Settings Help
Selection Project
1. Selection Data
Database: Level 2
Change...
Select from: MaterialUniverse: All materials
2. Selection Stages
Chart/Index Limit Tree
Ready
Plotting and selection tools
MaterialUniverse: All materials
Custom
Define your own subset...
MaterialUniverse
All materials
Composites
Elastomers
Foams
Glasses
Metals and alloys
Natural materials
Non-technical ceramics
Polymers
Technical ceramics
ProcessUniverse
Joining
Shaping
Surface Treatment



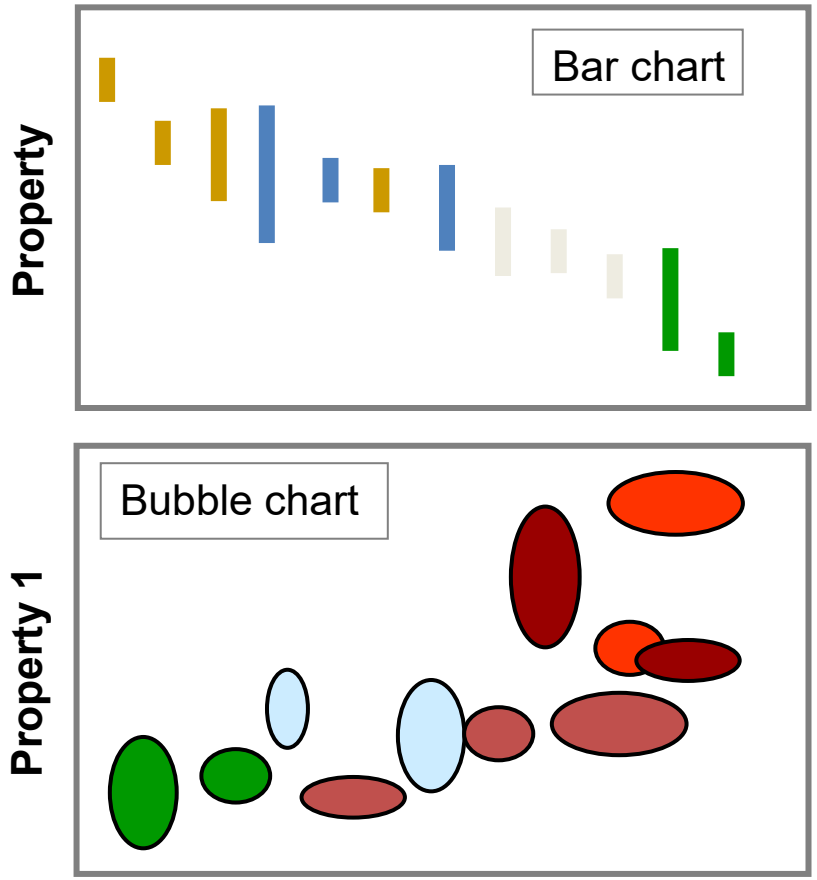


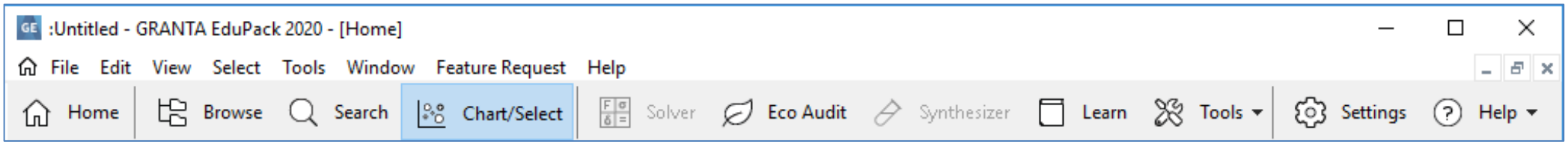
Choose:

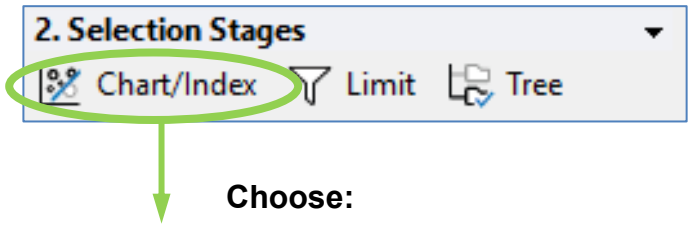
X-Axis	Y-Axis

List of properties

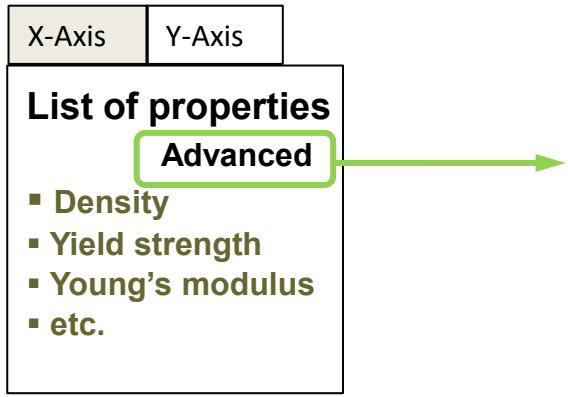
- **Density**
- **Yield strength**
- **Young's modulus**
- **etc.**

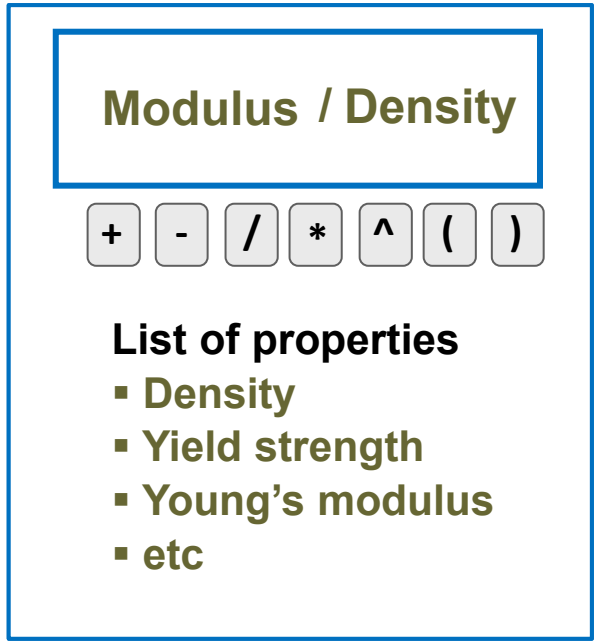


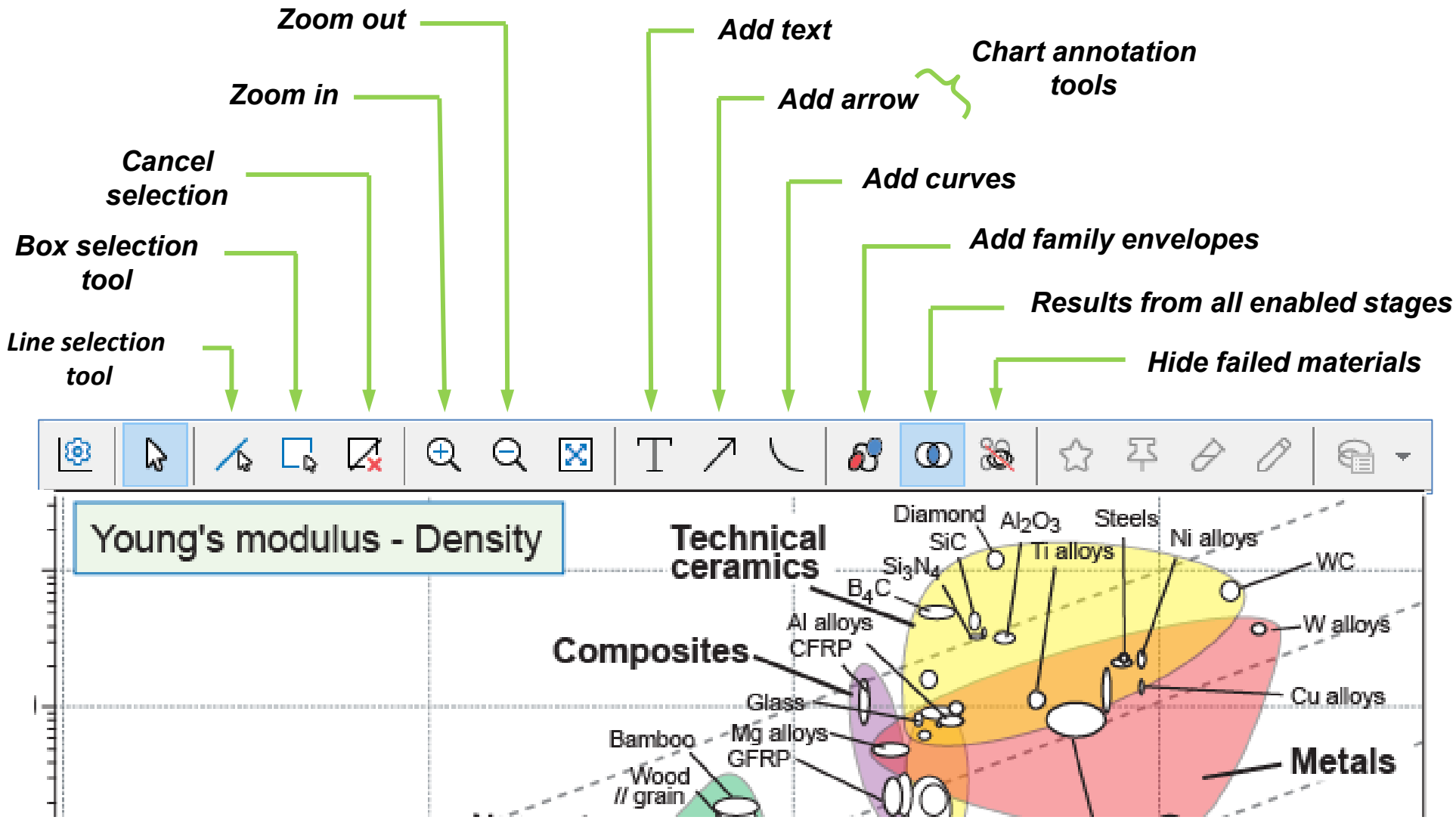

:Untitled - GRANTA EduPack 2020 - [Home]
File Edit View Select Tools Window Feature Request Help
Home Browse Search Chart/Select Solver Eco Audit Synthesizer Learn Tools Settings Help

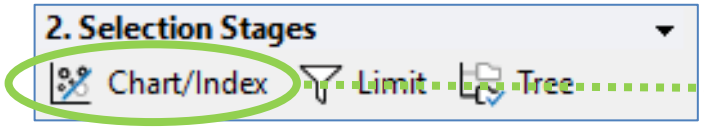

2. Selection Stages
Chart/Index
Limit
Tree

Choose:


X-Axis
Y-Axis
List of properties
Advanced
Density
Yield strength
Young's modulus
etc.


Modulus / Density
+ - / * ^ ( )
List of properties
Density
Yield strength
Young's modulus
etc

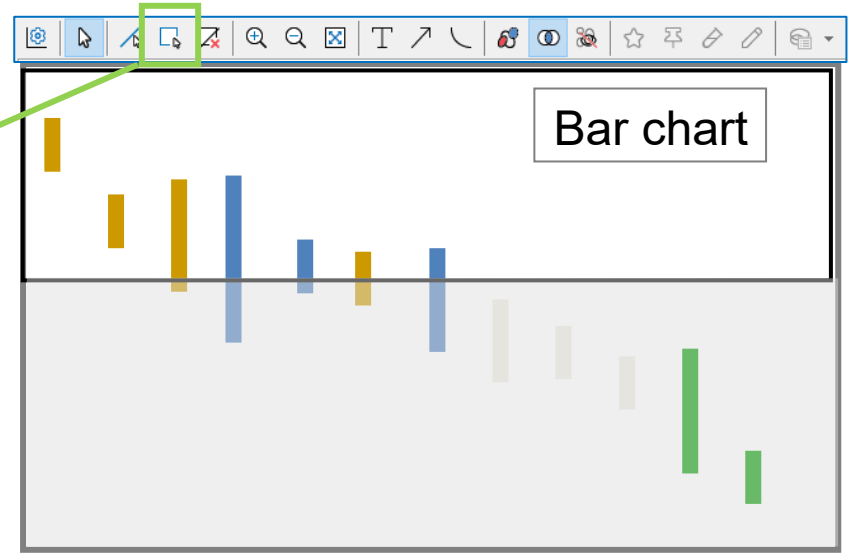

Zoom out
Zoom in
Cancel selection
Box selection tool
Line selection tool
Add text
Add arrow
Chart annotation tools
Add curves
Add family envelopes
Results from all enabled stages
Hide failed materials
Young's modulus - Density
Technical ceramics
Composites
Metals
Diamond
SiC
Al_2O_3
Steels
Ni alloys
Si_3N_4
Ti alloys
WC
B_4C
Al alloys
CFRP
W alloys
Glass
Cu alloys
Bamboo
Mg alloys
GFRP
Wood // grain

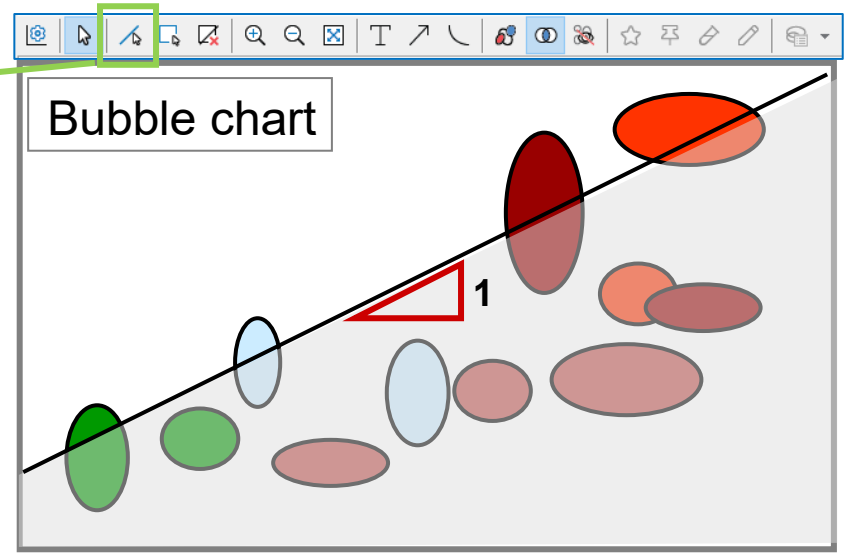


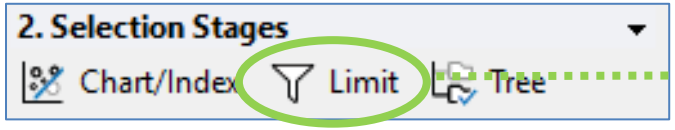
Box selection tool

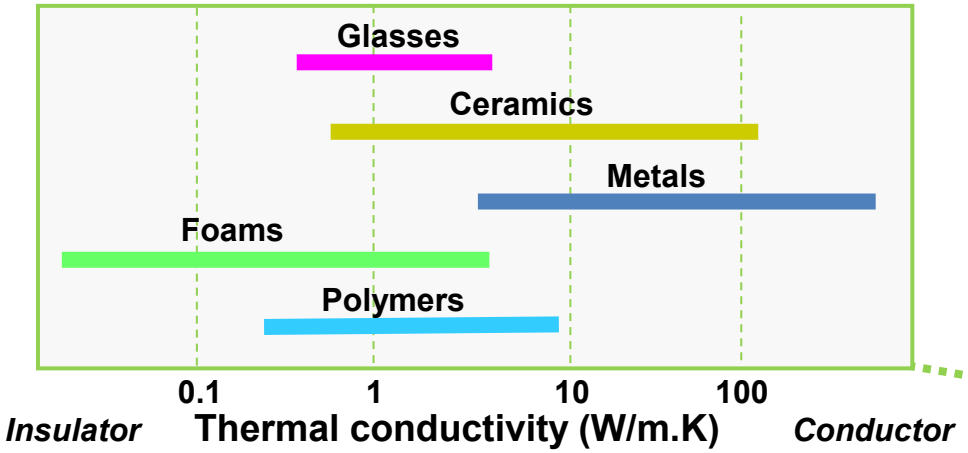
Line/gradient selection tool

Results	***Ranking***	
X out of 100 pass	***Prop 1***	***Prop 2***
Material 1	2230	113
Material 2	2100	300
Material 3	1950	5.6
etc...		

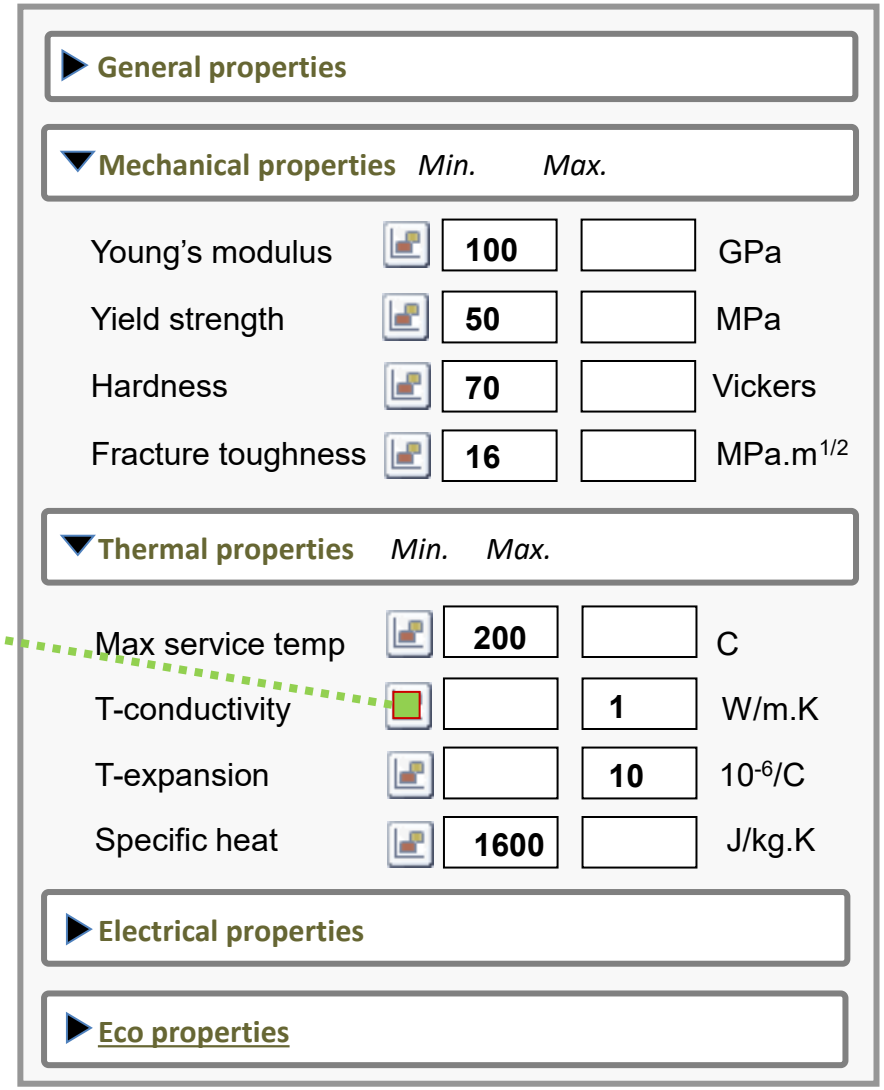


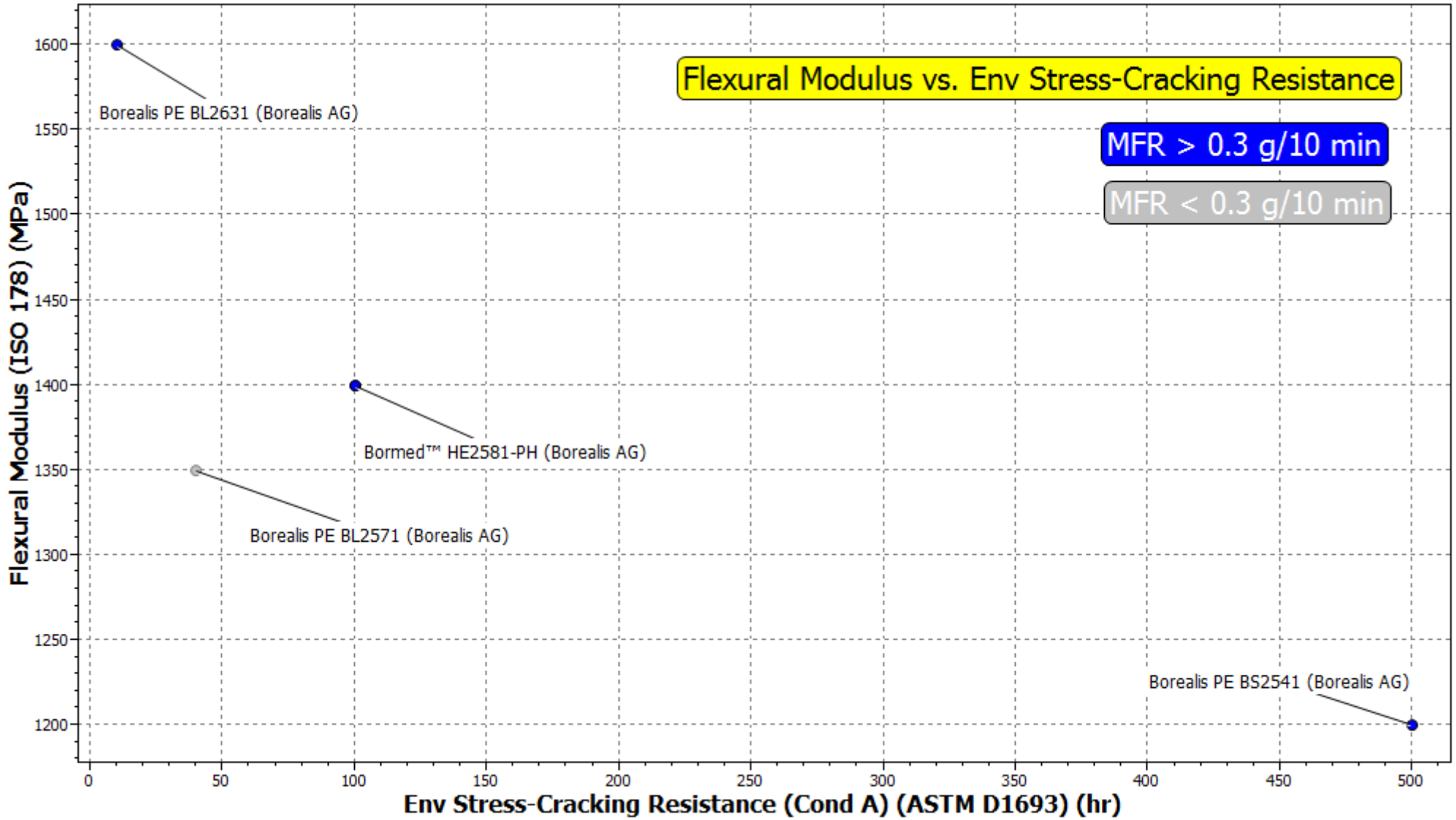


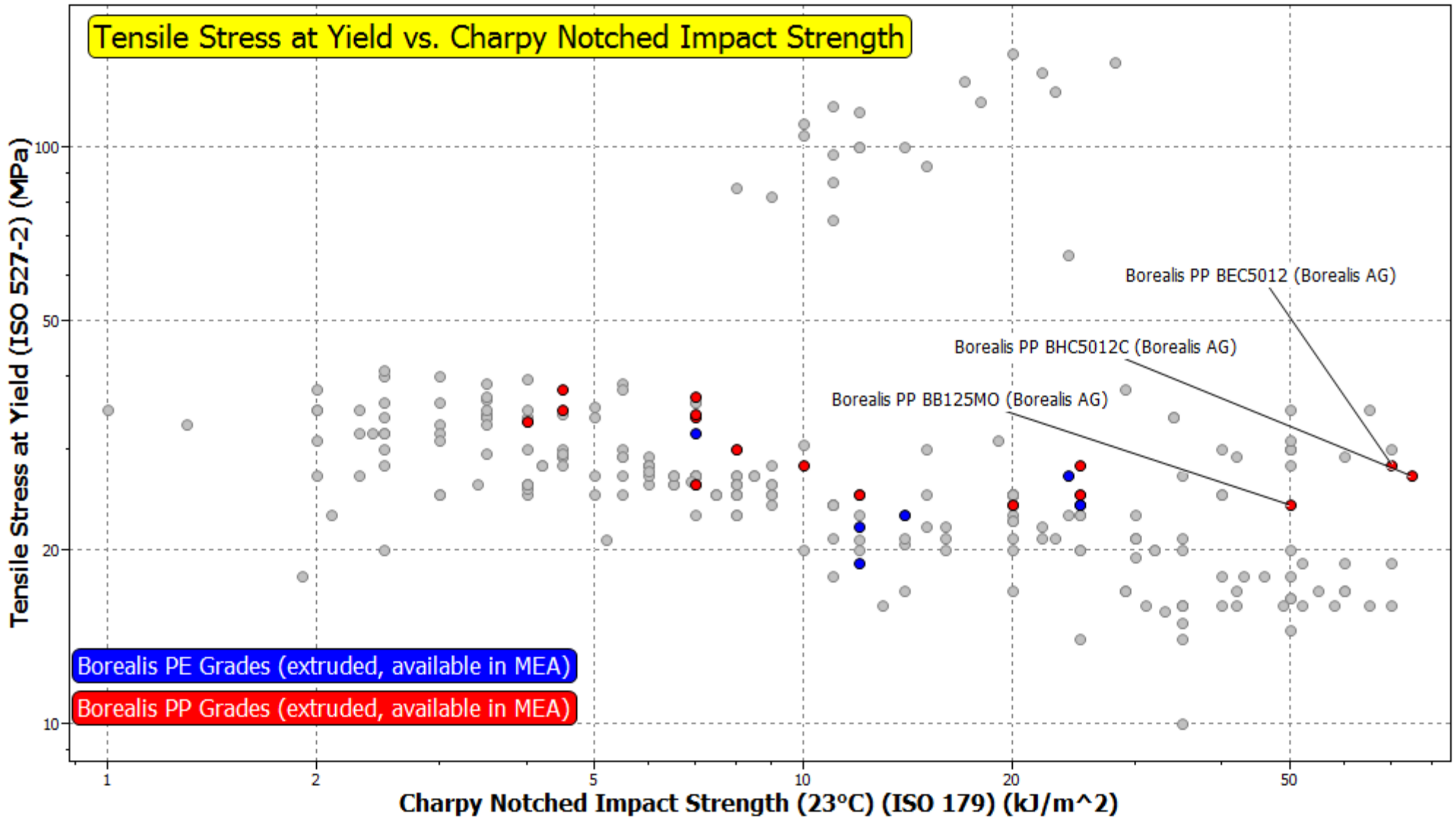


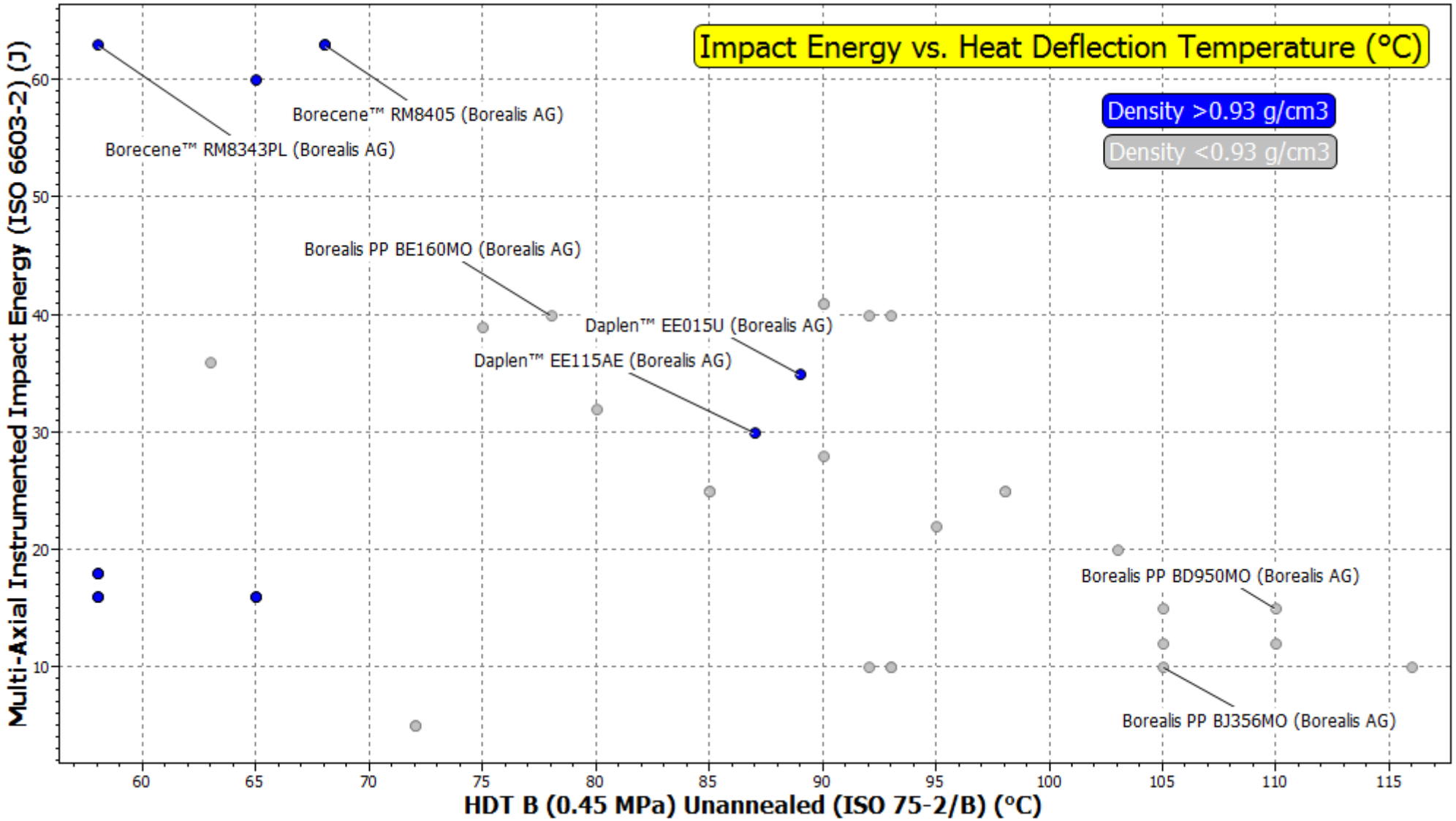


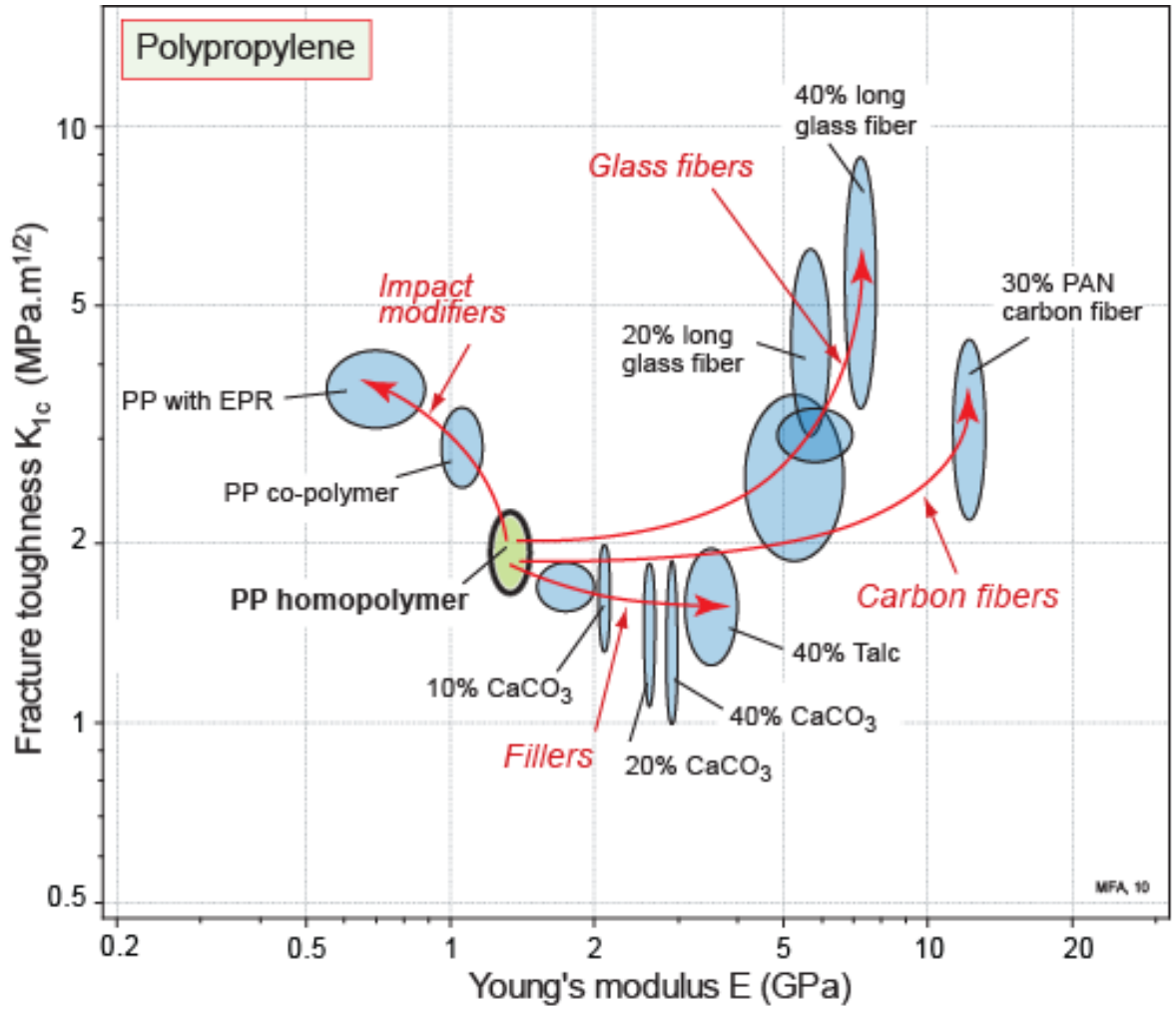
Results X out of 100 pass	Ranking Prop 1	Prop 2
Material 1	2230	113
Material 2	2100	300
Material 3	1950	5.6
etc...		




Flexural Modulus vs. Env Stress-Cracking Resistance
MFR > 0.3 g/10 min
MFR < 0.3 g/10 min
Borealis PE BL2631 (Borealis AG)
Bormed™ HE2581-PH (Borealis AG)
Borealis PE BL2571 (Borealis AG)
Borealis PE BS2541 (Borealis AG)
Flexural Modulus (ISO 178) (MPa)
1600
1550
1500
1450
1400
1350
1300
1250
1200
0
50
100
150
200
250
300
350
400
450
500
Env Stress-Cracking Resistance (Cond A) (ASTM D1693) (hr)


Tensile Stress at Yield vs. Charpy Notched Impact Strength
Tensile Stress at Yield (ISO 527-2) (MPa)
100
50
20
10
1
2
5
10
20
50
Charpy Notched Impact Strength (23°C) (ISO 179) (kJ/m^2)
Borealis PP BEC5012 (Borealis AG)
Borealis PP BHC5012C (Borealis AG)
Borealis PP BB125MO (Borealis AG)
Borealis PE Grades (extruded, available in MEA)
Borealis PP Grades (extruded, available in MEA)


Impact Energy vs. Heat Deflection Temperature (°C)
Density >0.93 g/cm3
Density <0.93 g/cm3
Borecene™ RM8405 (Borealis AG)
Borecene™ RM8343PL (Borealis AG)
Borealis PP BE160MO (Borealis AG)
Daplen™ EE015U (Borealis AG)
Daplen™ EE115AE (Borealis AG)
Borealis PP BD950MO (Borealis AG)
Borealis PP BJ356MO (Borealis AG)
Multi-Axial Instrumented Impact Energy (ISO 6603-2) (J)
HDT B (0.45 MPa) Unannealed (ISO 75-2/B) (°C)
10
20
30
40
50
60
60
65
70
75
80
85
90
95
100
105
110
115


Polypropylene
40% long glass fiber
Glass fibers
Impact modifiers
30% PAN carbon fiber
20% long glass fiber
PP with EPR
PP co-polymer
PP homopolymer
Carbon fibers
40% Talc
10% CaCO3
40% CaCO3
Fillers
20% CaCO3
MFA, 10
Fracture toughness K1c (MPa.m1/2)
Young's modulus E (GPa)
10
5
2
1
0.5
0.2
0.5
1
2
5
10
20

جامعة الإمارات العربية المتحدة
United Arab Emirates University
UAEU

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Resources

- Text: ***"Materials: engineering, science, processing and design"*** 4th edition by M.F. Ashby, H.R. Shercliff and D. Cebon, Butterworth Heinemann, Oxford, 2019, Chapters 1-2
- Text: ***"Materials Selection in Mechanical Design",*** 5th edition by M.F. Ashby, Butterworth Heinemann, Oxford, 2016, Chapters 1-2
- Texts: ***Callister, Budinski, Askeland and others*** – recommended reading in records
- Software: ***GRANTA EduPack*** (www.grantadesign.com/education)