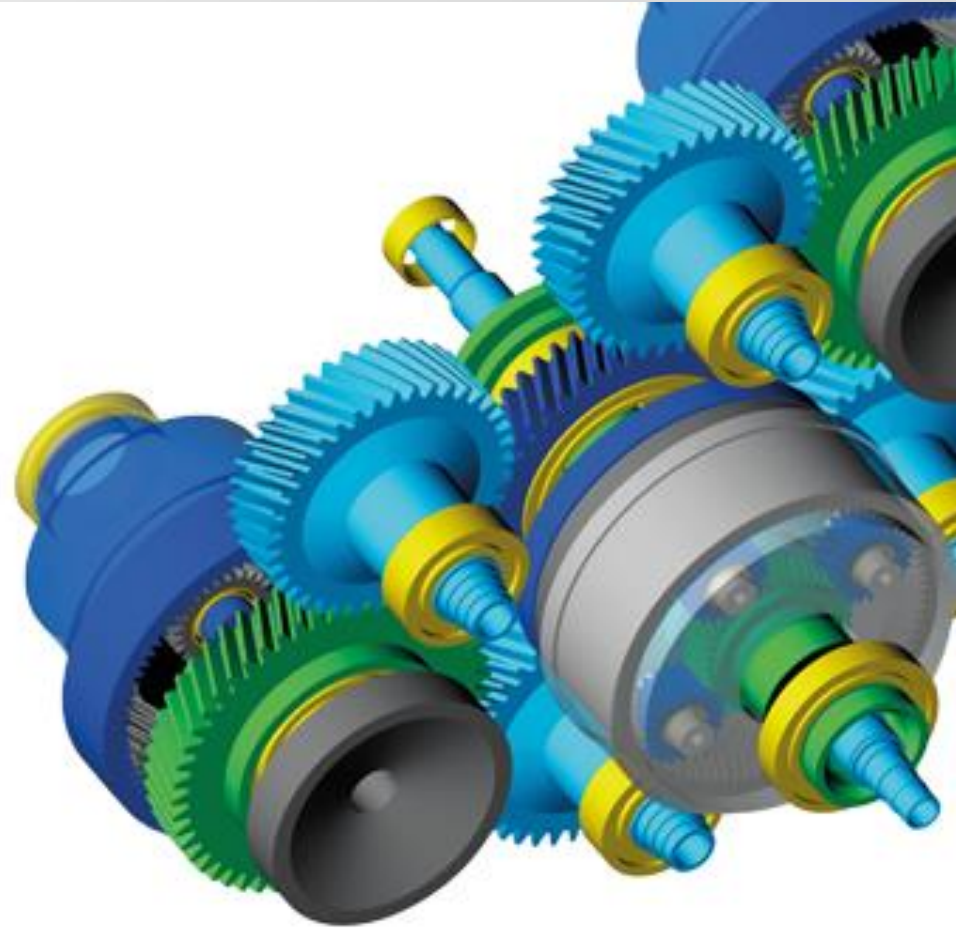


KISSsoft

Reseller Meeting 2017

Aljaž Pogačnik
Development
KISSsoft AG



- 1. New plastic material data in 2017 release**
- 2. New calculation options with plastic materials**
- 3. Plastics Manager (new module)**

New plastic material data in 2017 release

New materials added

- Genestar N1000A (PA9T) by Kuraray
 - Genestar N1001A (PA9T) by Kuraray
 - Genestar N1002A (PA9T) by Kuraray
 - Grivory HTV5H1 (PPA) by EMS
- } Fatigue data under measurement

Root fatigue data added

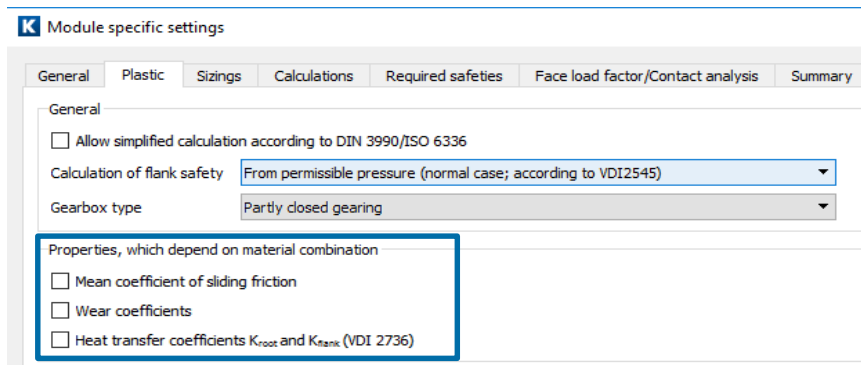
- Lubricomp KA000M (POM+aramide) by Sabic
- Lubricomp KL004 (POM+PTFE) by Sabic
- Lubricomp RAL23 (PA66+AF+PTFE) by Sabic

Summary

Open source:	25 materials
On request:	26 materials
Total:	51 materials
Root fatigue:	34 materials
Flank fatigue:	13 materials
Wear data:	38 materials

New calculation options with plastic materials

Properties, which depend on material combination



Coefficient of friction

- File **CoefficientOfFriction.DAT** in DAT folder

```
-- Coefficient of friction for plastic/plastic combination
-- Combination PA66(VDI2736) and POM(VDI2736)
-- Lubricant type: 0-Oil 1-Grease 2-Dry running
:TABLE FUNCTION 10491_10492_COF
      INPUT X SchmierTyp TREAT LINEAR
DATA
      0      1      2
      0      0.2  0.40
END

-- Coefficient of friction for plastic/steel combination
-- Material POM(VDI2736)
-- Lubricant type: 0-Oil 1-Grease 2-Dry running
:TABLE FUNCTION 10492_COF
      INPUT X SchmierTyp TREAT LINEAR
DATA
      0      1      2
      0      0.1  0.25
END
```

New calculation options with plastic materials

Properties, which depend on material combination

Module specific settings

General Plastic Sizings Calculations Required safeties Face load factor/Contact analysis Summary

General

Allow simplified calculation according to DIN 3990/ISO 6336

Calculation of flank safety From permissible pressure (normal case; according to VDI2545)

Gearbox type Partly closed gearing

Properties, which depend on material combination

Mean coefficient of sliding friction

Wear coefficients

Heat transfer coefficients K_{rot} and K_{stat} (VDI 2736)

Wear coefficient

- File **WearFactors.DAT** in DAT folder

```
-- Wear factor for plastic/plastic combination for dry running
-- Combination PA66(VDI2736)_POM(VDI2736)
-- in 10^-6 mm^3/Nm
:TABLE FUNCTION 10491_10492_dry
    INPUT X MaterialID TREAT LINEAR
    INPUT Y ZahnTempFlanke TREAT LINEAR
DATA
    10491    10492
40    2.00    1.05
60    5.60    6.50
80    12.0    10.4
END

-- Wear factor for plastic/steel combination at dry running
-- Combination PA66(VDI2736)_steel
-- in 10^-6 mm^3/Nm
:TABLE FUNCTION 10491_dry
    INPUT X MaterialID TREAT LINEAR
    INPUT Y ZahnTempFlanke TREAT LINEAR
DATA
    10491
40    6.10
60    10.6
80    20.1
END
```

New calculation options with plastic materials

Properties, which depend on material combination

K Module specific settings

General Plastic Sizings Calculations Required safeties Face load factor/Contact analysis Summary

General

Allow simplified calculation according to DIN 3990/ISO 6336

Calculation of flank safety From permissible pressure (normal case; according to VDI2545)

Gearbox type Partly closed gearing

Properties, which depend on material combination

Mean coefficient of sliding friction

Wear coefficients

Heat transfer coefficients K_{root} and K_{flank} (VDI 2736)

Heat transfer coefficient (VDI 2736)

- File **HeatTransferCoefficient.DAT** in DAT folder
- For the calculation of gear temperatures

```
-- Heat transfer factor Kflank for plastic/plastic combination
-- Combination PA66(VDI2736)_POM(VDI2736)
:TABLE FUNCTION 10491_10492_Kflank_dry
      INPUT X MaterialID TREAT LINEAR
DATA
      10491      10492
      2400      2400
END

-- Heat transfer factor Kroot for plastic/steel combination
-- Material POM(VDI2736)
:TABLE FUNCTION 10492_Kroot_dry
      INPUT X MaterialID TREAT LINEAR
DATA
      10492
      500
END
```

Plastics Manager (new module)

Located under various

Functionality

- Adding new plastic materials to the KS database
- Automatic generation of the corresponding DAT files

If fatigue data from gear testing is available

- Calculation of permissible tooth root/flank stresses
- Statistical evaluation of cycles to failure

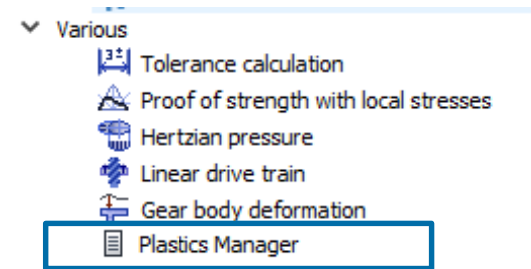
2 calculation cases possible

- Identical test gears for all tests (testing on the test bench)
- Different test gears used (Z12, Z14, Z15, Z16) – mainly testing in actual applications

Possible to calculate wear factors and heat transfer coefficients acc. to the VDI 2736

Possible customers

- Companies that do their own testing of plastic gears
- Companies that add plastic materials to KS databases

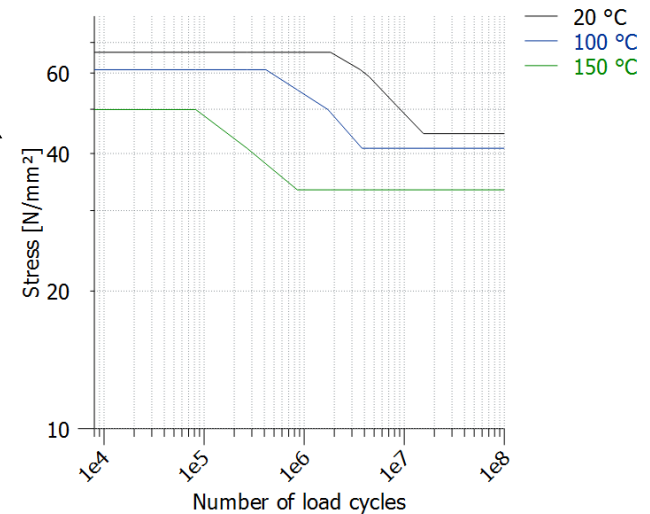


Plastics Manager (new module)

How to get permissible root/flank stresses from gear measurements?

	Torque, Nm	Speed, rpm	Cycles, 10 ⁶	Room T, °C	Root T, °C (failed gear)	Flank T, °C (failed gear)	Flank T, °C (counter gear)	Failure
1	4.50	500	15.345	20	20	20	20	root
2	4.50	500	15.821	20	20	20	20	root
3	3.39	500	0.874	150	150	150	150	root
4	3.39	500	0.834	150	150	150	150	root
5	5.20	500	8.347	20	20	20	20	root
6	5.20	500	8.167	20	20	20	20	root
7	4.18	500	3.849	100	100	100	100	root
8	4.18	500	3.725	100	100	100	100	root
9	4.18	500	0.254	150	150	150	150	root
10	4.18	500	0.284	150	150	150	150	root
11	5.08						0	root
12	5.08						0	root
13	5.08						0	root
14	5.08	500	1.922	100	100	100	100	root
15	5.08	500	0.092	150	150	150	150	root
16	5.08	500	0.074	150	150	150	150	root
17	6.21	500	3.806	20	20	20	20	root
18	6.21	500	3.486	20	20	20	20	root
19	6.21	500	0.405	100	100	100	100	root
20	6.21	500	0.425	100	100	100	100	root
21	6.78	500	1.722	20	20	20	20	root
22	6.78	500	1.951	20	20	20	20	root

Results from gear tests



Simple solution:
Use KISSsoft

Plastics Manager (new module)

Basic data | Test data | Data extrapolation | DAT file

Calculation

Damage probability: 50.0000 % Statistical method: Acc. to VDI 2736-4

Merge temperature deviation $\Delta\theta_{merge}$: 1.0000 °C Test gear file: SABIC_standard_geometry.Z12

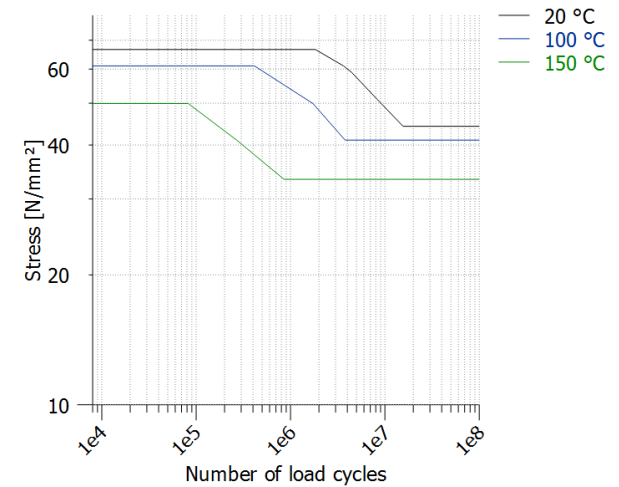
Torque merge deviation $\Delta T/T$: 1.0000 % Failed gear: 2

Group temperature deviation $\Delta\theta_{group}$: 1.0000 °C

Test gear measurements

Status	T [Nm]	n [1/min]	N _t [10 ⁴]	θ_u [°C]	$\theta_{GUT_{root}}$ [°C]	$\theta_{GUT_{rank}}$ [°C]	Failure mode	$\theta_{counter_{rank}}$ [°C]
7 active	4.1800	500.0000	3.8490	100.0000	100.0000	100.0000	Root	100.0000
8 active	4.1800	500.0000	3.7250	100.0000	100.0000	100.0000	Root	100.0000
9 active	4.1800	500.0000	0.2540	150.0000	150.0000	150.0000	Root	150.0000
10 active	4.1800	500.0000	0.2840	150.0000	150.0000	150.0000	Root	150.0000
11 active	6.0000	500.0000	4.5440	20.0000	20.0000	20.0000	Root	20.0000
12 active	6.0000	500.0000	4.3440	20.0000	20.0000	20.0000	Root	20.0000

Read data from file: C:/Users/apogacnik/Desktop/tests.DAT



Extrapolation options

Basic data | Test data | Data extrapolation | DAT file

Permissible tooth root stress

Method 1: Extrapolate with average slope Extend temperature range

Extrapolate to cycles: 10000.0000 10⁴ Extend to temperature θ_F : 0.0000 °C

Method 2: Set cycles to infinity Increase permissible stress by factor: 1.0000

```
-- Permissible tooth root stress sigFlim [N/mm2], all lubrication regimes
-- Calculated with 10% damage probability
-- Calculated with root safety factor SF=1
-- Values with * measured, other interpolated/extrapolated
:TABLE FUNCTION FootSigFlim
  INPUT X ZahnTempFuss TREAT LINEAR
  INPUT Y Lastwechsel TREAT LOG
DATA
      20      100      150
0.000e+000  33.3    30.5    25.0
7.709e+004  33.3    30.5    25.0*
2.492e+005  33.3    30.5    20.5*
3.839e+005  33.3    30.5*   19.0
7.865e+005  33.3    27.6    16.7
1.585e+006  33.3    25.0*   16.7
1.681e+006  33.3*   24.6    16.7
3.327e+006  30.5*   20.7    16.7
3.457e+006  30.3    20.5    16.7
4.053e+006  29.5*   20.5    16.7
7.503e+006  25.5*   20.5    16.7
1.411e+007  22.1    20.5    16.7
1.000e+009  22.1    20.5    16.7
END
```

Plastics Manager (new module)

Basic data Test data Data extrapolation DAT file

Calculation

Damage probability: 10.0000 % Statistical method: Normal distribution

Merge temperature deviation $\Delta\theta_{merge}$: 8.0000 °C

Root/flank stress merge deviation $\Delta\sigma/\sigma$: 5.0000 %

Group temperature deviation $\Delta\theta_{group}$: 5.0000 °C

Test gear measurements

	Status	Test gear file	Failed gear	Failure mode	Counter gear
1	inactive	4Gears2.Z16	2	No failure	1
2	inactive	4Gears1.Z16	2	No failure	1
3	active	3Gears2.Z15	2	Root	3
4	active	3Gears1.Z15	2	Root	3
5	active	3Gears8.Z15	2	Root	3
6	active	3Gears5.Z15	2	Root	3
7	active	3Gears6.Z15	2	Root	3
8	active	3Gears4.Z15	2	Root	3

Read data from file:

Module specific settings

Minimum number of data points for merging: 2

Minimum number of data points for grouping: 2

Allowable cycles to failure deviation: 30.0000 %

Allowable speed deviation: 5.0000 %

Stress correction factor of reference test gear Y_{ST} : 2.0000

Root safety: SF_{min} : 1.0000

Flank safety: SH_{min} : 1.0000

Power-on time: 100.0000 %

Housing heat-transfer resistance: $R_{1/2}$: 0.0000 K²m²/W

Housing heat-dissipating surface: A_S : 0.0100 m²

Single test file

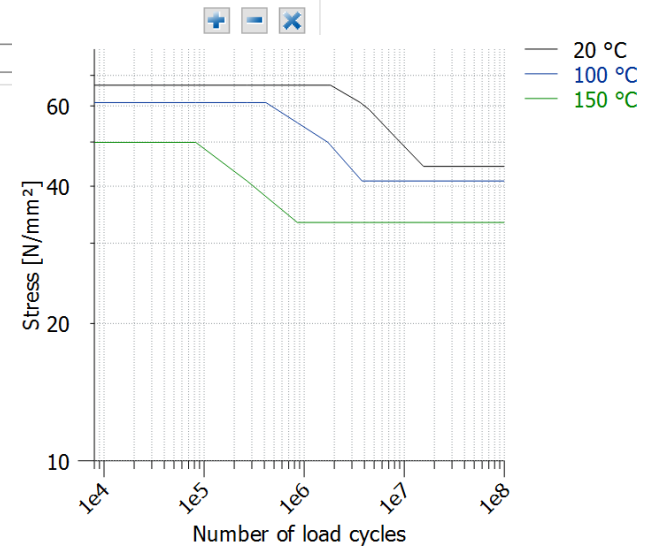
Calculate wear coefficient from worn test gear

Display permissible root/flank stresses in LOG scale

OK Cancel

Possible KS files: Z12, Z14, Z15, Z16

Additional calculation of heat transfer coefficients and wear factors acc. to the VDI 2736 possible.



Thank you!
Any Questions?

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Reseller Meeting
April 2017

