# Description of a PMP – Example Project

PMP Project: D12_M1C1Bil_mit_Teilung: Evaluating a Grinding Circuit

Normally a test will take place in order to evaluate a grinding circuit. Therefore particle size distributions (PSD) and mass streams are defined. Strategies for evaluating can be developed with the PMP-software, and important apparatus characteristic curves and models can be derived from these information. Via complex comparisons, the PMP-Software shows advices of representativeness and robustness of the measuring datas as well as their balanced preparation.
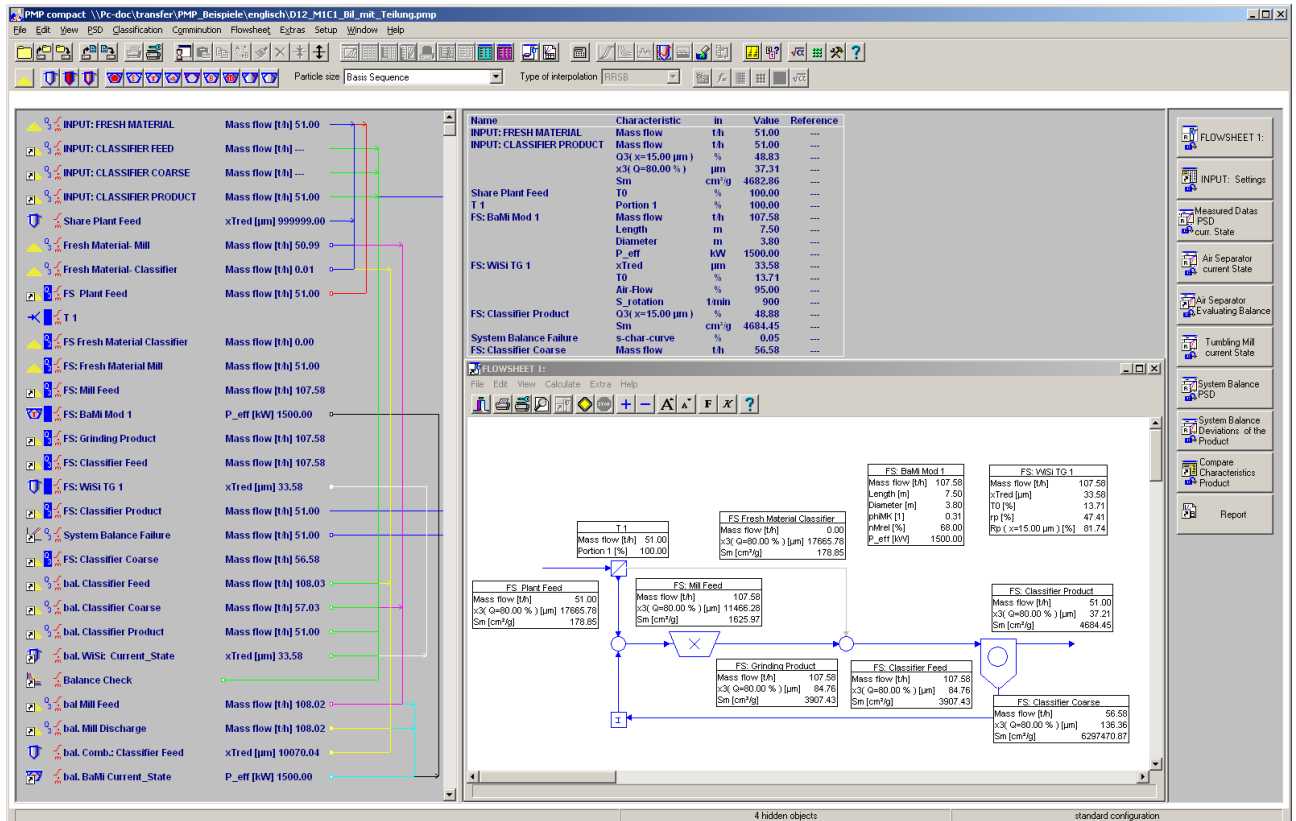
The above figure shows a project which solves a complex balance task at a single grinding circuit. On the left side, the data structures for solving the task are available. The measured information (INPUT) of

- fresh material   PSD and mass stream

- classification product   PSD and mass stream

- classification coarse material   PSD

- classification feed   PSD

- splitter   split ratio

- classifier   rotor rotational speed, air flow

- mill   power input, size

serves as initial values, which are filed at the first 4 objects.

From these objects, new data structures will be created via directed balance calculations. The calculations are marked with coloured connections:

- ☐ blue: calculation 1: reproduction of the splitting of the fresh material

- ☐ red   calculation 2: transfer plant feed into the fresh material of the flowsheet

- ☐ green   calculation 3: calculate tromp curve (three PSD's and a mass stream)

- ☐ yellow   calculation 4: calculate mill discharge (balance at the combination classification feed)

- ☐ pink   calculation 5: calculate mill feed (Mixture of fresh material fraction and classification coarse material)

- ☐ turquoise   calculation 6: calculate characteristic curve for the comminution

- ☐ white   calculation 7: transfer tromp curve into flowsheet

- ☐ black   calculation 8: transfer mill characteristic curve into flowsheet
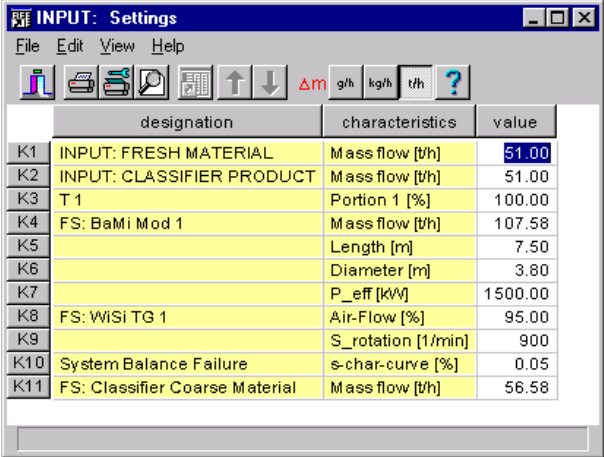
Therewith all balance calculations are created and the current apparatus descriptions are available at the flowsheet. The calculation of the steady state can occur. For evaluating measured datas, balance methods and models, the measured steady state can be compared with the measured datas. At the project, the comparison between the calculated product (steady state) and the preset product occurs (blue: calculation 9).

The results are displayed at views, which are filed at the right side of the project window at the TG-manager. This concerns different views, where

- ☐ input templates

- ☐ diagram- and table presentations with results of the balance calculation

- ☐ result overviews

are filed at flowsheet, diagram and table form. A summarize of the results occurs at the PMP-Report (see page 5: PMP circuit M1C1 Balance- and Simulation Calculations). At the following some interesting presentations are selected.

1. Summarize of input datas

	designation	characteristics	value
K1	INPUT: FRESH MATERIAL	Mass flow [t/h]	51.00
K2	INPUT: CLASSIFIER PRODUCT	Mass flow [t/h]	51.00
K3	T 1	Portion 1 [%]	100.00
K4	FS: BaMi Mod 1	Mass flow [t/h]	107.58
K5		Length [m]	7.50
K6		Diameter [m]	3.80
K7		P_eff [kW]	1500.00
K8	FS: WiSi TG 1	Air-Flow [%]	95.00
K9		S_rotation [1/min]	900
K10	System Balance Failure	s-char-curve [%]	0.05
K11	FS: Classifier Coarse Material	Mass flow [t/h]	56.58

2. Presentation of results of the classification balance:

   Tromp curve and

   Balanced PSD's

Machine: Air Separator — **Bal. PSD's and Tromp Curve**

Legend:
- bal. Classifier Feed
- bal. Classifier Coarse Material
- bal. Classifier Fine Material
- bal. WiSi: Current_State

X-axis: Particle Size / µm
Left Y-axis: PSD: Q3(x) / %
Right Y-axis: Partition Number T(x) / %
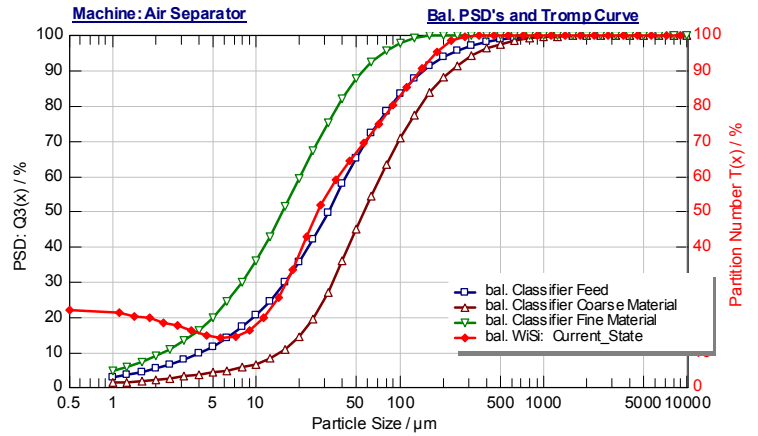
3. Presentation of results of the mill balance (balance of mill model 13 with the energy characteristic curve

Machine: Tumbling Mill — **bal. PSD's and Grinding Curve**

Legend:
- bal Mill Feed
- bal. Mill Discharge
- bal. BaMi Current_State

X-axis: Particle Size / µm
Left Y-axis: Q3(x) / %
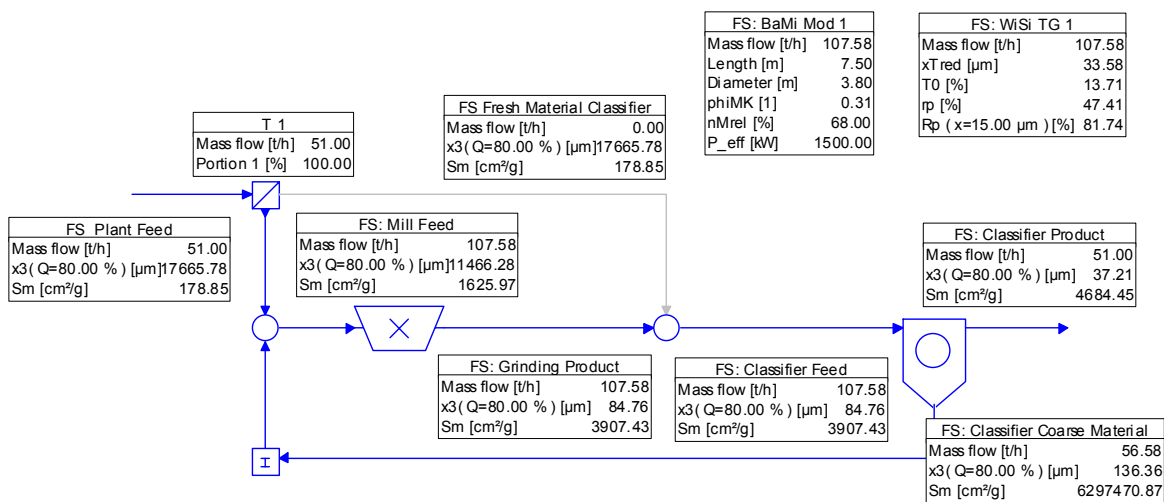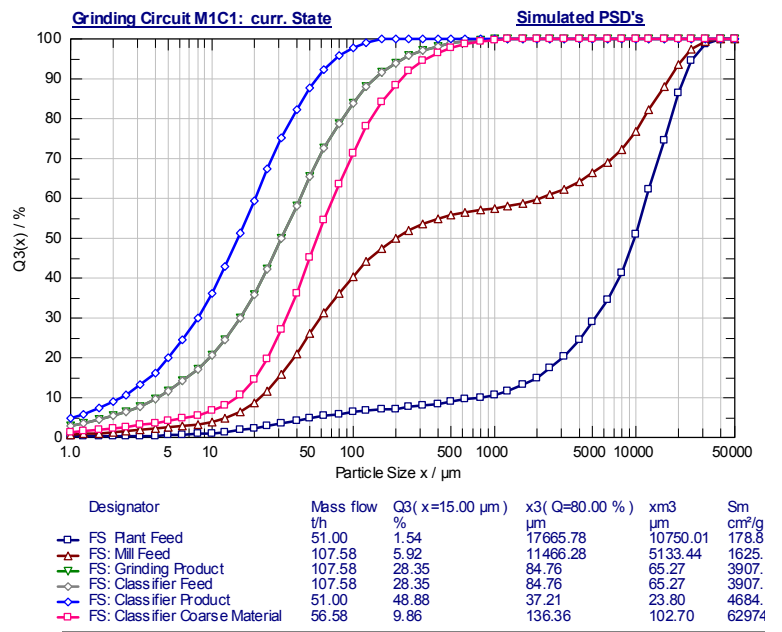Right Y-axis: W_inv / kWh/t
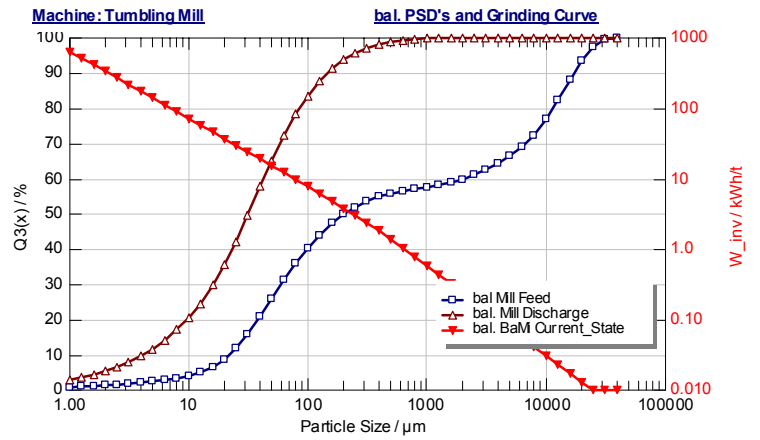
4. Results of the simulation at steady state:

   Flowsheet

FS: BaMi Mod 1	
Mass flow [t/h]	107.58
Length [m]	7.50
Diameter [m]	3.80
phiMK [1]	0.31
nMrel [%]	68.00
P_eff [kW]	1500.00

FS: WiSi TG 1	
Mass flow [t/h]	107.58
xTred [µm]	33.58
T0 [%]	13.71
rp [%]	47.41
Rp (x=15.00 µm)[%]	81.74

T 1	
Mass flow [t/h]	51.00
Portion 1 [%]	100.00

FS Fresh Material Classifier	
Mass flow [t/h]	0.00
x3(Q=80.00 %) [µm]	17665.78
Sm [cm²/g]	178.85

FS Plant Feed	
Mass flow [t/h]	51.00
x3(Q=80.00 %) [µm]	17665.78
Sm [cm²/g]	178.85

FS: Mill Feed	
Mass flow [t/h]	107.58
x3(Q=80.00 %) [µm]	11466.28
Sm [cm²/g]	1625.97

FS: Classifier Product	
Mass flow [t/h]	51.00
x3(Q=80.00 %) [µm]	37.21
Sm [cm²/g]	4684.45

FS: Grinding Product	
Mass flow [t/h]	107.58
x3(Q=80.00 %) [µm]	84.76
Sm [cm²/g]	3907.43

FS: Classifier Feed	
Mass flow [t/h]	107.58
x3(Q=80.00 %) [µm]	84.76
Sm [cm²/g]	3907.43

FS: Classifier Coarse Material	
Mass flow [t/h]	56.58
x3(Q=80.00 %) [µm]	136.36
Sm [cm²/g]	6297470.87

5. Results of the simulation at steady state:

    PSD's at the circuit

Designator	Mass flow t/h	Q3(x =15.00 µm) %	x3(Q=80.00 %) µm	xm3 µm	Sm cm²/g
FS: Plant Feed	51.00	1.54	17665.78	10750.01	178.8
FS: Mill Feed	107.58	5.92	11466.28	5133.44	1625.
FS: Grinding Product	107.58	28.35	84.76	65.27	3907.
FS: Classifier Feed	107.58	28.35	84.76	65.27	3907.
FS: Classifier Product	51.00	48.88	37.21	23.80	4684.
FS: Classifier Coarse Material	56.58	9.86	136.36	102.70	62974

6. Evaluating measured datas of the grinding product via comparison of the PSD of the product and the PSD resulted via the simulation at the steady state. Basis are the apparatus curves, resulted via the balances at the steady state.

The average deviation consists of the balance failures at
- the splitter and the combinations
- the classifier
- the mill
and the system simulation failure at the steady states

Results:

All tasks, from comparibility of measured datas until simulation calculations at a steady state including representative result views, are formulated at this PMP-project. The building of this project occurs via a well directed selection of methods. This project can be filed as template and used for any futher evaluation. The carring out occurs at three steps:
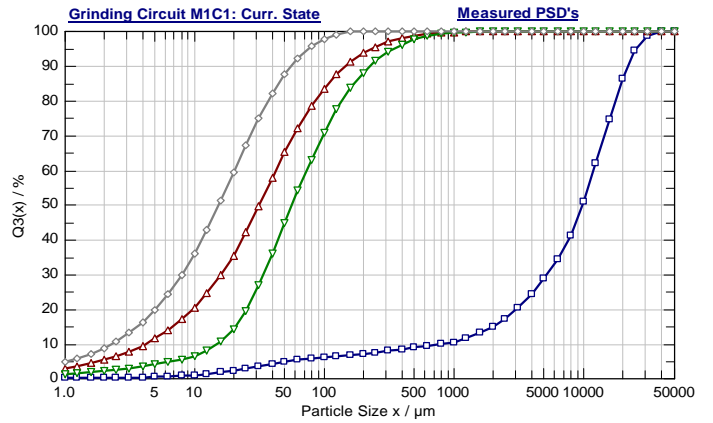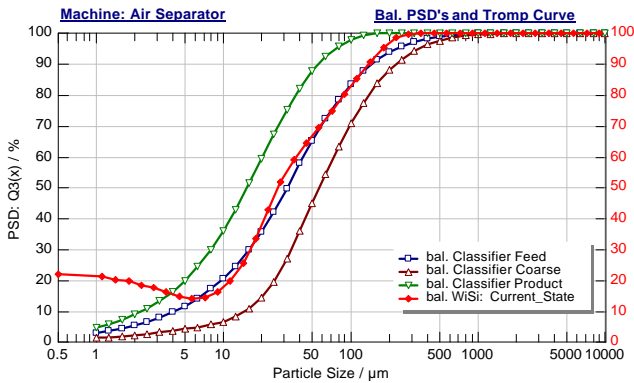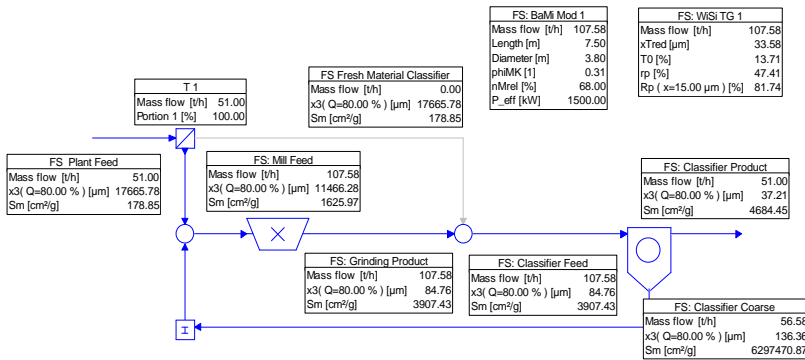
1. allocate INPUT-structures and input templates with current datas

2. start calculations: calculate actionlist and flowsheet

3. evaluate results at views, characteristic values and print report.

The project can be adjusted at any changed situation.

P M P   Circuit M1C1 : Balance- and Simulation Calculations

Project description: D12_M1C1_Bil_mit_Teilung
Balancing at a simple grinding circuit M1C1
and
considering the split ratio
1.) calculating machine characteristics for classifier and mill
2.) simulating same situation at the circuit
3.) evaluating balance and simulation

FS: BaMi Mod 1

Mass flow [t/h]	107.58
Length [m]	7.50
Diameter [m]	3.80
phiMK [1]	0.31
nMrel [%]	68.00
P_eff [kW]	1500.00

FS: WiSi TG 1

Mass flow [t/h]	107.58
xTred [µm]	33.58
T0 [%]	13.71
rp [%]	47.41
Rp (x=15.00 µm) [%]	81.74

T 1

Mass flow [t/h]	51.00
Portion 1 [%]	100.00

FS Fresh Material Classifier

Mass flow [t/h]	0.00
x3 (Q=80.00 %) [µm]	17665.78
Sm [cm²/g]	178.85

FS Plant Feed

Mass flow [t/h]	51.00
x3(Q=80.00 %) [µm]	17665.78
Sm [cm²/g]	178.85

FS: Mill Feed

Mass flow [t/h]	107.58
x3(Q=80.00 %) [µm]	11466.28
Sm [cm²/g]	1625.97

FS: Classifier Product

Mass flow [t/h]	51.00
x3(Q=80.00 %) [µm]	37.21
Sm [cm²/g]	4684.45

FS: Grinding Product

Mass flow [t/h]	107.58
x3(Q=80.00 %) [µm]	84.76
Sm [cm²/g]	3907.43

FS: Classifier Feed

Mass flow [t/h]	107.58
x3(Q=80.00 %) [µm]	84.76
Sm [cm²/g]	3907.43

FS: Classifier Coarse

Mass flow [t/h]	56.58
x3(Q=80.00 %) [µm]	136.36
Sm [cm²/g]	6297470.87

Machine: Air Separator — Bal. PSD's and Tromp Curve

- bal. Classifier Feed
- bal. Classifier Coarse
- bal. Classifier Product
- bal. WiSi: Current_State

Machine: Tumbling Mill — bal. PSD's and Grinding Curve

- bal Mill Feed
- bal. Mill Discharge
- bal. BaMi Current_State

Grinding Circuit M1C1 Current State — Aver. Deviation of the Products

The average deviation consists of the balance failures at
- the splitter and the combinations
- the classifier
- the mill
and the system simulation failure at the steady states

Grinding Circuit M1C1: Curr. State — Measured PSD's

Designator	Mass flow t/h	Q3(x=15.00 µm) %	x3(Q=80.00 %) µm	xm3 µm	Sm cm²/g
FS Plant Feed	51.00	1.54	17665.78	10750.01	178.85
INPUT: CLASSIFIER FEED	---	28.20	85.91	69.38	3907.47
INPUT: CLASSIFIER COARSE	---	9.78	138.71	110.05	10270198.21
INPUT: CLASSIFIER PRODUCT	51.00	48.83	37.31	23.86	4682.86
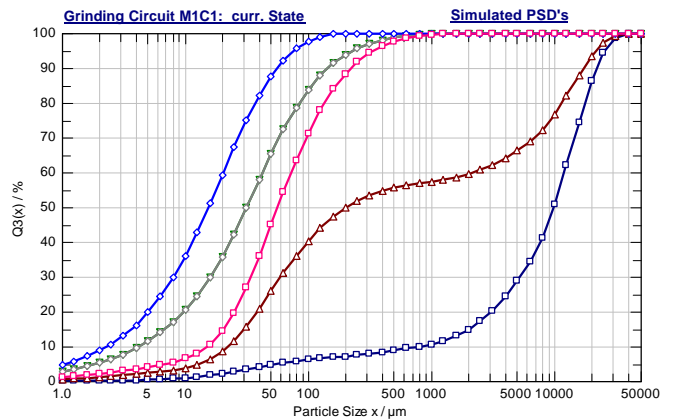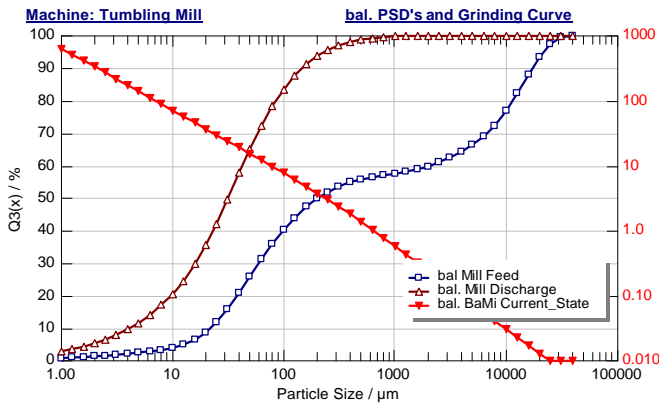
Grinding Circuit M1C1: curr. State — Simulated PSD's

Designator	Mass flow t/h	Q3(x=15.00 µm) %	x3(Q=80.00 %) µm	xm3 µm	Sm cm²/g
FS Plant Feed	51.00	1.54	17665.78	10750.01	178.85
FS: Mill Feed	107.58	5.92	11466.28	5133.44	1625.97
FS: Grinding Product	107.58	28.35	84.76	65.27	3907.43
FS: Classifier Feed	107.58	28.35	84.76	65.27	3907.43
FS: Classifier Product	51.00	48.88	37.21	23.80	4684.45
FS: Classifier Coarse	56.58	9.86	136.36	102.70	6297470.87