COMPUTER PROGRAMMES FOR MINERAL PROCESSING PRESENTATION

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Abstract

In this paper will be shown computer application of softwares Minteh-5, Minteh-6 and Cyclone in Visual Basic, Visual Studio for presentation of two-products for some closed circuits od grinding-clasifying processes.

These methods make possibilities for appropriate, fast and sure presentation of some complex circuits in the mineral processing technologies.

Key words: Mineral Processing Technology, computer programmes, hydrocyclone, algorithams, codes.

Наслов на македонски: Компјутерски програми за презентација на процесите во Минералната технологија

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Краток извадок: Во овој труд ќе бидат прикажани компјутерските софтверски апликации Minteh – 5, Minteh – 6 и Cyclone креирани во Visual Basic, Visual Studio за презентација на два – продукта за некои затворени циклуси во процесите на мелење – класирање.

Овие методи даваат можностите за соодветна, брза и сигурна презентација на некои комплексни кола во Технологијата на минерални суровини.

Introduction

In the recent Mineral Processing Technology the application of the computer programmes and simulation of the present processes has had the goal to ensure the first step of eventual automation of the technological processes.

The applied computer programmes for sensitivity of the mass equation, the Maximising the accurancy of two-product recovery computations (ISKLIM and MASLIM), the computer programmes for estimation of efficiency, kinetic or separation of the minerals (monominerals or polyminerals) (KINETIC), also the computer programmes for daily, monthly, yearly reports for mineral processing activities (Mine SASA), computer programm for Evolutive Operativity (EVOP) are the true and real path and goal for strongly input in programming and simulation in the different processes in mineral processing.

Computer programmes for Mineral Processing in Basic

In this paper are explained the computer programmes ***CYCLONE, WEGHTRE, WILMAN,*** using Basic support which one easily may be transformed into another one computer language or computer packet.

By the way, ***WEGHTRE*** (Reconcillation of excass data by weighted least squares) or ***WILMAN*** (Reconcillation of excass data by variances in mass equation) are computer programmes which help to eliminate the long and heavy estimation and calculation for the processes which produce two products.

The application of the computer programm ***CYCLONE*** has contributed for eficiently presentation for presentation of the determination of particular essential characteristic in the hydrocyclone operation, eficently determination of the mill product diameter the hydrocyclone diameter or another data which is for interest for investigators or for programmer

The procedures, algorithams and codes may be used for all Mineral processing processes, for the industrial and laboratory investigations etc.

References

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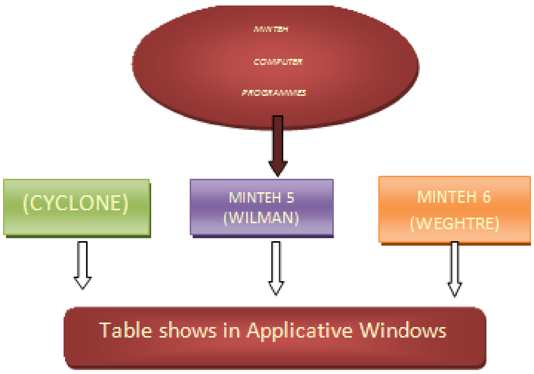
ПРИЛОЗИ



SPECIAL PART (Programmes)

MINTEH 6

WEGHTRE – PROGRAM

```
REM WEGHTRE BY B.A.WILLS 20 FEB.1985
REM ESTIMATION OF BEST FLOW RATE BY WEIGHTED RESIDUALS
REM LEAST SQUARES FOLLOWED BY LAGRANGIAN METHOD
PRINT"Nature of input (e.g.feed , rougher con,":PRINT"etc":INPUTF$
PRINT"Nature of product 1 (e.g concentrate,
":PRINT"cyclone o/f,etc":INPUTP$
PRINT"Nature of product 2":INPUTQ$
PRINT"Number of components (e.g.assays, water/solids, size fractions, etc)":INPUTN
PRINT"Do all components have equal relative":INPUT"error Y/N? "FR$
IF FR$="Y" THEN E=1
DIMC$(N):DIMF(N):DIMP(N):DIMQ(N):
DIMAF(N):DIMAP(N):DIMAQ(N):DIMX(N):
DIME(N):DIMVF(N):DIMVP(N):DIMVQ(N)
```

```
FOR A=1 TO N
PRINT"Name of component"; A;" (e.g. %Sn,
":PRINT"water/solids,%125-250m, etc"
INPUTC$(A)
PRINTC$(A);"in";F$:INPUTF(A)
IF FR$="Y" THEN 170
INPUT"Estimated relative standard deviation %"E
VF(A)=E*E*F(A)*F(A)/10000
PRINTC$(A);"in";P$:INPUTP(A)
IF FR$="Y" THEN 210
INPUT"Estimated relative standard deviation %"E
VP(A)=E*E*P(A)*P(A)/10000
PRINTC$(A);"in";Q$:INPUTQ(A)
IF FR$="Y" THEN 250
INPUT"Estimated relative standard deviation %"E
VQ(A)=E*E*Q(A)*Q(A)/10000
NEXTA
REM CALC X
REM BEST FIT X=D/G WHERE D=SUM OF
(F-Q)(P-Q)/SUM OF SQR(P-Q)
D=0:G=0
FOR B=1 TO N
X(B)=100*(F(B)-Q(B))/(P(B)-Q(B))
D=D+(((F(B)-Q(B))*(P(B)-Q(B))))
G=G+((P(B)-Q(B))*(P(B)-Q(B)))
NEXTB
XB=D/G:REM XB=BEST FIT X WITH NO WEIGHTING
REM CALCULATION OF WEIGHTED BEST FIT
CB=XB
DW=0:GW=0:C=CB
FOR H=1 TO N
VR=VF(H)+(C*C*VP(H))+((1-C)*(1-C)*VQ(H))
GW=GW+((P(H)-Q(H))*(P(H)-Q(H)))/VR
DW=DW+(((F(H)-Q(H))*(P(H)-Q(H))))/VR
NEXT H
```

RUN 1-Particular Sizes

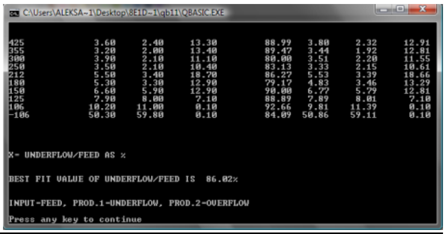
```
CB=DW/GW:REM WEIGHTED ESTIMATE
IF ABS(CB-C)<0.005 THEN 470
GOTO 380
XB=CB
REM CALCS OF ADJUSTED COMPONENTS
FOR J=1 TO N
K=VF(J)+(XB*XB*VP(J))+((1-XB)*(1-XB)*VQ(J))
E(J)=F(J)-(XB*P(J))-(Q(J)*(1-XB))
AF(J)=F(J)-(E(J)*VF(J)/K)
AP(J)=P(J)+(E(J)*XB*VP(J)/K)
AQ(J)=Q(J)+((E(J)*(1-XB)*VQ(J))/K)
A=E(J)*VF(J)/K:B=E(J)*XB*VP(J)/K:C=
E(J)*(1-XB)*VQ(J)/K
NEXT J
PRINTTAB(25);"ACTUAL";TAB(63);"ADJUSTED"
PRINT"COMPONENT";
PRINTTAB(15);"INPUT";TAB(24);"PROD.1";
TAB(34);"PROD.2";TAB(48);"X";TAB(55);
"INPUT";TAB(64);"PROD.1";TAB(74);"PROD.2"
@%=&2020A:REM SETS 2 DECIMAL PLACES
AND FORMATS FIELD WIDTH
PRINT:PRINT
FOR Z=1 TO N
PRINTC$(Z),F(Z),P(Z),Q(Z),X(Z),AF(Z),AP(Z),AQ(Z)
NEXTZ
PRINT:PRINT:PRINT:PRINT:PRINT" X= ";P$;"/";F$;" AS %"

PRINT:PRINT:PRINT"BEST FIT VALUE OF ";P$;"/";F$;

" IS ";XB*100;"%"

PRINT:PRINT:PRINT"INPUT=";F$;",

PROD.1=";P$;", PROD.2=";Q$
```



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425	3.60	2.40	13.30	88.99	3.80	2.32	12.91
355	3.20	2.00	13.40	89.47	3.44	1.92	12.81
300	3.90	2.10	11.10	80.00	3.51	2.20	11.55
250	3.50	2.10	10.40	83.13	3.33	2.15	10.61
212	5.50	3.40	18.70	86.27	5.53	3.39	18.66
180	5.30	3.30	12.90	79.17	4.83	3.46	13.29
150	6.60	5.90	12.90	90.00	6.77	5.79	12.81
125	7.90	8.00	7.10	88.89	7.89	8.01	7.10
106	10.20	11.00	0.10	92.66	9.81	11.39	0.10
-106	50.30	59.80	0.10	84.09	50.86	59.11	0.10

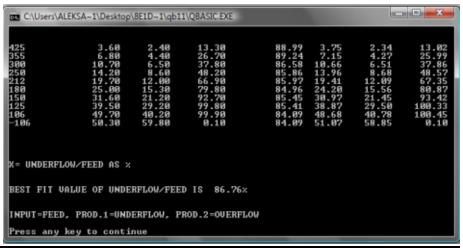
X- UNDERFLOW/FEED AS %

BEST FIT VALUE OF UNDERFLOW/FEED IS 86.02%

INPUT-FEED, PROD.1-UNDERFLOW, PROD.2-OVERFLOW

Press any key to continue

RUN 2 – Cumulative Sizes



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425	3.60	2.40	13.30	88.99	3.75	2.34	13.02
355	6.80	4.40	26.70	89.24	7.15	4.27	25.99
300	10.70	6.50	37.80	86.58	10.66	6.51	37.86
250	14.20	8.60	48.20	85.86	13.96	8.68	48.57
212	19.70	12.00	66.90	85.97	19.41	12.09	67.35
180	25.00	15.30	79.80	84.96	24.20	15.56	80.87
150	31.60	21.20	92.70	85.45	30.97	21.45	93.42
125	39.50	29.20	99.80	85.41	38.87	29.50	100.33
106	49.70	40.20	99.90	84.09	48.68	40.78	100.45
-106	50.30	59.80	0.10	84.09	51.07	58.85	0.10

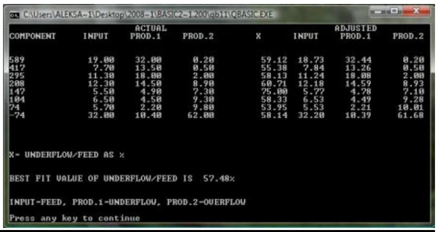
X= UNDERFLOW/FEED AS %

BEST FIT VALUE OF UNDERFLOW/FEED IS 86.76%

INPUT=FEED, PROD.1=UNDERFLOW, PROD.2=OVERFLOW

Press any key to continue

RUN 3 - Particular Sizes (Industrial data for underflow diameters d_p=100mm and d_p=110mm)



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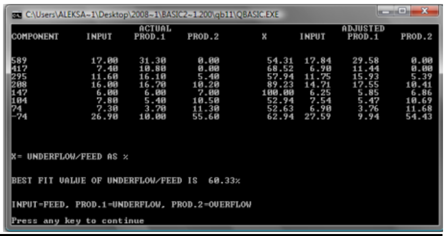
COMPONENT	INPUT	ACTUAL PROD.1	PROD.2	X	INPUT	ADJUSTED PROD.1	PROD.2
589	19.00	32.00	0.20	59.12	18.73	32.44	0.20
417	7.70	13.50	0.50	55.38	7.84	13.26	0.50
295	11.30	18.00	2.00	58.13	11.24	18.08	2.00
208	12.30	14.50	8.90	60.71	12.18	14.59	8.93
147	5.50	4.90	7.30	75.00	5.77	4.78	7.10
104	6.50	4.50	9.30	58.33	6.53	4.49	9.28
74	5.70	2.20	9.80	53.95	5.53	2.21	10.01
-74	32.00	10.40	62.00	58.14	32.20	10.39	61.68

X- UNDERFLOW/FEED AS %

BEST FIT VALUE OF UNDERFLOW/FEED IS 57.48%

INPUT-FEED, PROD.1-UNDERFLOW, PROD.2-OVERFLOW

Press any key to continue



C:\Users\ALEKSA~1\Desktop\2008~1\BASIC2~1.200\qb11\QBASIC.EXE

COMPONENT	INPUT	ACTUAL PROD.1	PROD.2	X	INPUT	ADJUSTED PROD.1	PROD.2
589	17.00	31.30	0.00	54.31	17.84	29.58	0.00
417	7.40	10.80	0.00	68.52	6.90	11.44	0.00
295	11.60	16.10	5.40	57.94	11.75	15.93	5.39
208	16.00	16.70	10.20	89.23	14.71	17.55	10.41
147	6.00	6.00	7.00	100.00	6.25	5.85	6.86
104	7.80	5.40	10.50	52.94	7.54	5.47	10.69
74	7.30	3.70	11.30	52.63	6.90	3.76	11.68
-74	26.90	10.00	55.60	62.94	27.59	9.94	54.43

X= UNDERFLOW/FEED AS %

BEST FIT VALUE OF UNDERFLOW/FEED IS 60.33%

INPUT-FEED, PROD.1-UNDERFLOW, PROD.2-OVERFLOW

Press any key to continue

MINTEH – 5

WILMAN – PROGRAM

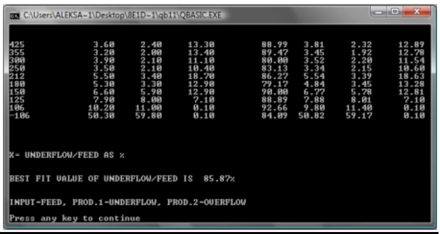
```
REM WILMAN BY B.A.WILLS 20 FEB.1985
REM ESTIMATION OF BEST FLOW RATE BY VARIANCE
IN COMPONENT EQUATIONS
DATA ADJUSTMENT BY LAGRANGIAN MULTIPLIERS
PRINT"Nature of input (e.g.feed , rougher con,
":PRINT"etc":INPUTF$
PRINT"Nature of product 1 (e.g concentrate,
":PRINT"cyclone o/f,etc":INPUTP$
PRINT"Nature of product 2":INPUTQ$
PRINT"Number of components (e.g.assays,
water/solids, size fractions, etc)":INPUTN
PRINT"Do all components have equal relative
":INPUT"error Y/N?      "FR$
IF FR$="Y" THEN E=1
DIMC$(N):DIMF(N):DIMP(N):DIMQ(N):DIMAF(N):
DIMAP(N):DIMAQ(N):DIMX(N):DIME(N):DIMVF(N):
DIMVP(N):DIMVQ(N)
FOR A=1 TO N
PRINT"Name of component"; A;" (e.g. %Sn,
 ":PRINT"water/solids,%125-250m, etc"
INPUTC$(A)
PRINTC$(A);"in";F$:INPUTF(A)
IF FR$="Y" THEN 170
INPUT"Estimated relative standard deviation %"E
VF(A)=E*E*F(A)*F(A)/10000
PRINTC$(A);"in";P$:INPUTP(A)
IF FR$="Y" THEN 210
INPUT"Estimated relative standard deviation %"E
VP(A)=E*E*P(A)*P(A)/10000
PRINTC$(A);"in";Q$:INPUTQ(A)
IF FR$="Y" THEN 250
INPUT"Estimated relative standard deviation %"E
VQ(A)=E*E*Q(A)*Q(A)/10000
NEXTA
REM CALC X
```

```
FOR B=1 TO N
X(B)=100*(F(B)-Q(B))/(P(B)-Q(B))
NEXTB
REM CALCULATION OF WEIGHTED BEST FIT
DW=0:GW=0
FOR H=1 TO N
AA=VF(H)/((P(H)-Q(H))*(P(H)-Q(H)))
BB=VP(H)*(F(H)-Q(H))*(F(H)-Q(H))/((P(H)-Q(H))*(P(H)-Q(H))*(P(H)-Q(H))* (P(H)-Q(H))
CC=VQ(H)*(P(H)-F(H))*(P(H)-F(H))/((P(H)-Q(H))*(P(H)-Q(H))*(P(H)-Q(H))* (P(H)-Q(H))
VC=AA+BB+CC
DW=DW+((F(H)-Q(H))/((P(H)-Q(H))*SQR(VC)))
GW=GW+(1/SQR(VC))
NEXT H
XB=DW/GW
REM CALCS OF ADJUSTED COMPONENTS
FOR J=1 TO N
K=VF(J)+(XB*XB*VP(J))+((1-XB)*(1-XB)*VQ(J))
E(J)=F(J)-(XB*P(J))-(Q(J)*(1-XB))
AF(J)=F(J)-(E(J)*VF(J)/K)
AP(J)=P(J)+(E(J)*XB*VP(J)/K)
AQ(J)=Q(J)+((E(J)*(1-XB)*VQ(J))/K)
A=E(J)*VF(J)/K:B=E(J)*XB*VP(J)/K:C=E(J)*(1-XB)*VQ(J)/K
NEXT J
PRINTTAB(25);"ACTUAL";TAB(63);" ADJUSTED"
PRINT"COMPONENT";
PRINTTAB(15);"INPUT";TAB(24);"PROD.1";TAB(34);
"PROD.2";TAB(48);"X";TAB(55);"INPUT";TAB(64);
"PROD.1";TAB(74);"PROD.2"
 @%=&2020A: REM SETS 2 DECIMAL PLACES
 AND FORMATS FIELD WIDTH
PRINT:PRINT
FOR Z=1 TO N
PRINTC$(Z),F(Z),P(Z),Q(Z),X(Z),AF(Z),AP(Z),AQ(Z)
NEXTZ
```

MINTEH – 4

```
PRINT:PRINT:PRINT:PRINT:PRINT" X= ";P$;"/";F$;" AS %"

PRINT:PRINT:PRINT"BEST FIT VALUE OF ";P$;"/";F$;

" IS ";XB*100;"%"

PRINT:PRINT:PRINT"INPUT=";F$;", PROD.1=";P$;",

PROD.2=";Q$
```

RUN 1-Particular Sizes



425	3.60	2.40	13.30	88.99	3.81	2.32	12.89
355	3.20	2.00	13.40	89.47	3.45	1.92	12.78
300	3.90	2.10	11.10	80.00	3.52	2.20	11.54
250	3.50	2.10	10.40	83.13	3.34	2.15	10.60
212	5.50	3.40	18.70	86.27	5.54	3.39	18.63
180	5.30	3.30	12.90	79.17	4.84	3.45	13.28
150	6.60	5.90	12.90	90.00	6.77	5.78	12.81
125	7.90	8.00	7.10	88.89	7.88	8.01	7.10
106	10.20	11.00	0.10	92.66	9.80	11.40	0.10
-106	50.30	59.80	0.10	84.09	50.82	59.17	0.10

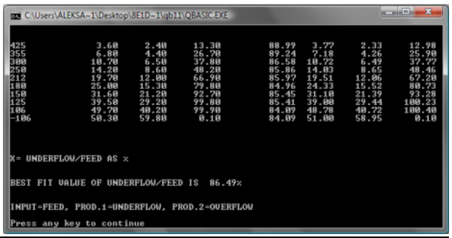
X= UNDERFLOW/FEED AS %

BEST FIT VALUE OF UNDERFLOW/FEED IS 85.87%

INPUT=FEED, PROD.1=UNDERFLOW, PROD.2=OVERFLOW

Press any key to continue

RUN 2 – Cumulative Sizes



425	3.60	2.40	13.30	88.99	3.77	2.33	12.98
355	6.80	4.40	26.70	89.24	7.18	4.26	25.90
300	10.70	6.50	37.80	86.58	10.72	6.49	37.77
250	14.20	8.60	48.20	85.86	14.03	8.65	48.46
212	19.70	12.00	66.90	85.97	19.51	12.06	67.20
180	25.00	15.30	79.80	84.96	24.33	15.52	80.73
150	31.60	21.20	92.70	85.45	31.10	21.39	93.28
125	39.50	29.20	99.80	85.41	39.00	29.44	100.23
106	49.70	40.20	99.90	84.09	48.78	40.72	100.40
-106	50.30	59.80	0.10	84.09	51.00	58.95	0.10

X= UNDERFLOW/FEED AS %

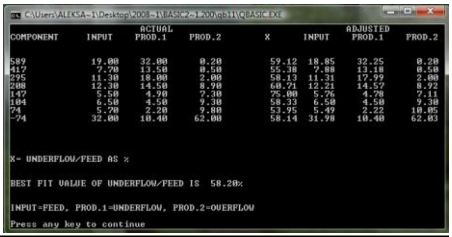
BEST FIT VALUE OF UNDERFLOW/FEED IS 86.49%

INPUT=FEED, PROD.1=UNDERFLOW, PROD.2=OVERFLOW

Press any key to continue

RUN 3 - Particular Sizes (Industrial data for

underflow diametars d_p=100mm and d_p=110mm)



	ACTUAL					ADJUSTED	
COMPONENT	INPUT	PROD.1	PROD.2	X	INPUT	PROD.1	PROD.2
589	19.00	32.00	0.20	59.12	18.85	32.25	0.20
417	7.70	13.50	0.50	55.38	7.88	13.18	0.50
295	11.30	18.00	2.00	58.13	11.31	17.99	2.00
208	12.30	14.50	8.90	60.71	12.21	14.57	8.92
147	5.50	4.90	7.30	75.00	5.76	4.78	7.11
104	6.50	4.50	9.30	58.33	6.50	4.50	9.30
74	5.70	2.20	9.80	53.95	5.49	2.22	10.05
-74	32.00	10.40	62.00	58.14	31.98	10.40	62.03

X= UNDERFLOW/FEED AS %

BEST FIT VALUE OF UNDERFLOW/FEED IS 58.20%

INPUT=FEED, PROD.1=UNDERFLOW, PROD.2=OVERFLOW

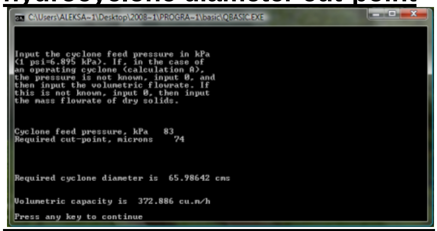
Press any key to continue

CYCLONE – PROGRAM

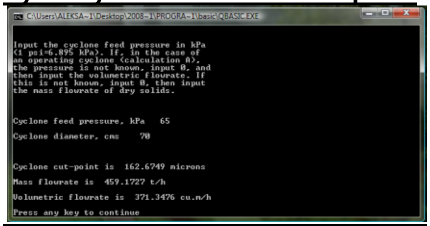
```
10REM HYDROCYCLONE CALCULATIONS BY KREBS-MULAR-JULL FORMULAE
20REM A.KRSTEV 3 JULY 2008
30PRINT:PRINTTAB(7);"HYDROCYCLONE CALCULATIONS"
40PRINTTAB(7);"****************************"
50PRINT:PRINT:PRINT"A.Determination of cut-point (and"
60PRINT:"capacity) of standard cyclone of known":PRINT"diameter"
70PRINT:PRINT:PRINT"B. Determination of diameter of cyclone"
80PRINT"needed to give required cut-point"
90PRINT:PRINT:PRINT:INPUT"Input A, or B "A$
100PRINT:PRINT"INSERT FOLLOWING FEED DATA:"
110PRINT:PRINT:INPUT"S.G. of dry solids, kg/l   "S
120PRINT:PRINT"Feed % solids by weight"
130INPUT"(If only slurry density known, input 0)    "x
140 IF x<>0 THEN D=100*S/((100*S)+x-(x*S)):GOTO 170
150PRINT:PRINT:INPUT"Slurry density, kg/l   "D
160x=100*S*(D-1)/(D*(S-1))
170V=x*D/S
180PRINT:PRINT:PRINT:PRINT"Input the cyclone feed pressure in kPa"
190PRINT"(1 psi=6.895 kPa). If, in the case of"
200PRINT"an operating cyclone (calculation A),"
210PRINT"the pressure is not known, input 0, and"
220PRINT"then input the volumetric flowrate. If"
230PRINT"this is not known, input 0, then input"
240PRINT"the mass flowrate of dry solids."
250PRINT:PRINT:PRINT:INPUT"Cyclone feed pressure, kPa   "P
260 IF P<>0 THEN 310
270PRINT:PRINT:INPUT"Feed flowrate, cu.m/h  "Q
280 IF Q<>0 THEN M=Q*D*x/100:GOTO 310
290PRINT:PRINT:INPUT"Feed mass flowrate, t/h    "M
300Q=100*M/(x*D)
310IF A$="B" THEN 450
320REM CALCULATIONS A
330PRINT:INPUT"Cyclone diameter, cms    "Dc
340 IF P=0 THEN 370
350Q=0.0094*(P^0.5)*Dc*Dc
360M=Q*D*x/100
370d50=0.77*(Dc^1.875)*EXP(-.301+(.0945*V)-(.00356*V*V)+(.0000684*V*V*V))/((Q^0.6)*((S-1)^0.5))
380PRINT:PRINT:GOSUB 520
390 GOSUB 580
400IFP<>0 THEN END
410P=(Q^2)/((.0094^2)*(Dc^4))
420P1=P/6.895
430PRINT"Cyclone pressure is ";P;"kPa"
440PRINT" (";P1;"psi)":END
450 REM CALCULATIONS B
460INPUT"Required cut-point, microns    "d50
470Dc=(d50^1.481)*((S-1)^.741)*(.0094^.889)*(P^.444)/((.77^1.481)*(EXP(-.301+(.0945*V)-(.00356*V*V)+(.0000684*V*V*V))^1.481))
480Q=0.0094*(P^.5)*Dc*Dc
490M=Q*D*x/100
500PRINT:PRINT:PRINT:GOSUB 520
510 GOSUB 640:END
520 REM SUBROUTINE
530IF Q<1 THEN Q=Q*1000:B$="litres/h":GOTO 550
540B$="cu.m/h"
```

```
550IF M<1 THEN M=1000*M:C$="kg/h":GOTO 570
560C$="t/h"
570 RETURN
580 REM SUBROUTINE
590@%=131594: REM SETS 2 DECIMALS PLACES
600PRINT:PRINT"Cyclone cut-point is ";d50;"microns"
610PRINT:PRINT"Mass flowrate is ";M; C$
620PRINT:PRINT"Volumetric flowrate is ";Q; B$
630 RETURN
640 REM SUBROUTINE
650@%=131594: REM SETS 2 DECIMALS PLACES
660PRINT:PRINT"Required cyclone diameter is ";Dc; "cms"
670PRINT:PRINT:PRINT"Volumetric capacity is ";Q; B$
680 REM PRINT:PRINT:PRINT"Solids capacity is ";M; C$:RETURN
```

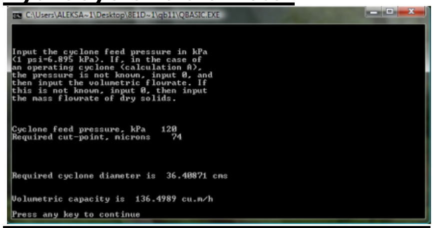
<u>RUN 1 – Determination of the hydrocyclone diameter cut-point</u>



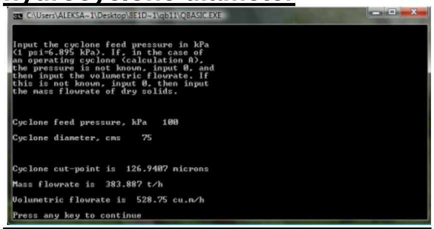
<u>RUN 2 – Determination of the hydrocyclone diameter cut-point</u>



<u>RUN 3 – Determination of the hydrocyclone diameter</u>



<u>RUN 4 – Determination of the hydrocyclone diameter</u>



CONCLUSION

It's clearly and simplify to concluse that the methods-models are suitable way to represent the minimisation or maximisation of the known problems. The application of these computer presentations using the examples of closed circuits are good examples for computer methods-models: ***softwares Minteh-5, Minteh-6 and Cyclone in Visual Basic, Visual Studio***.