

CP4 Computer programs relative to Paper 4

CP4.1 Calculation and curve of T1 as a function of ΔX

The curve on the computer screen is done by calling the "SUB AAPH_ARTNEG_trace()" routine.

Once the data have been recovered (See values displayed in the Tables of Paper 4 and in the Excel sheets of Supplement DA4), the experimental pT1 tensions from published articles and the pT1 theoretical curves from model equations are plotted as a function of the hs shortening (Fig CP4.1).

A regression is performed between experimental and theoretical tensions (see Methods section).

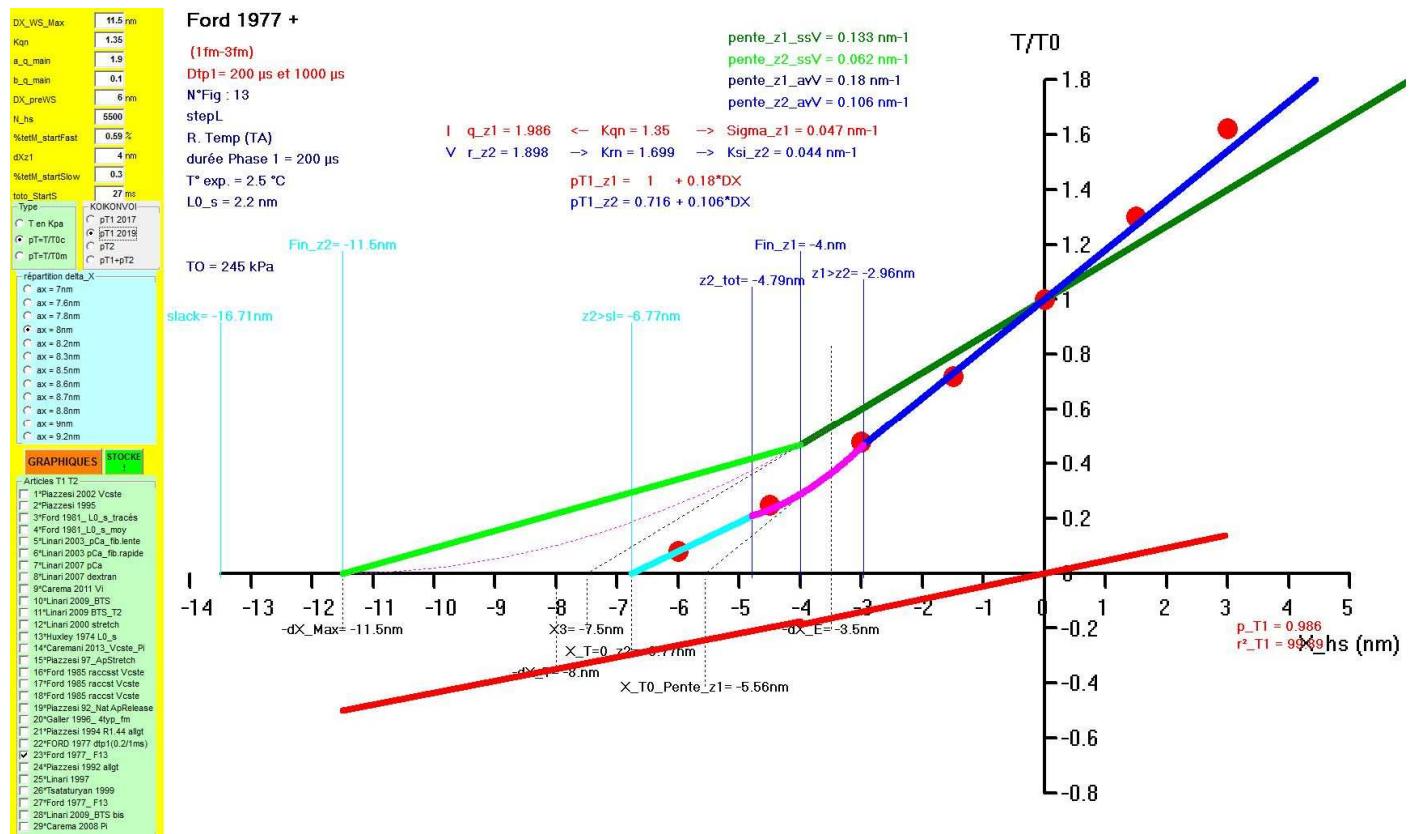


Fig CP4.1 Screenshot after starting the the "Sub AAPH_ARTNEG_trace()" routine.

Sub AAPH_ARTNEG_trace()

Dim choix_coul As Integer, droites_Vlisco As Integer, t_arti As Integer

droites_Vlisco = 1 'on voit les droites viscosité

'droites_Vlisco = 0 'par défaut

If Left(ressort.Tag, 4) <> "ph12" Then Stop

If mmm = 1 Then

 O.AutoRedraw = True: O.Cls 'verifier que fonction autoredraw=tue

 FrT2n.Visible = 0

'prepa pour prsentation tracés article

 With Frpres 'pres= presentaion 0="TOUT" 1="ART +DR_Visc +DR_Elast" 2="ART -DR_Visc +DR_Elast" 3="ART +DR_Visc -DR_Elast" 4="ART -DR_Visc -DR_Elast"

 .Top = Height * 0.35: .Left = Width * 0.9

 .Visible = -1

 End With

 For t = 0 To 4 '6

 With Opres(t)

 .Visible = -1

 .Caption = Choose(t + 1, "TOUT", "ART +DR_Visc +DR_Elast", "ART -DR_Visc +DR_Elast", "ART +DR_Visc -DR_Elast", "ART -DR_Visc -DR_Elast")

 End With

 Next

 FrTemp.Visible = 0

End If

Np4 = 100

e_pt = 25 * IIf(mmm = 1, 1, 3)

e_tt = 4 * IIf(mmm = 1, 1, 3)

L_WS = Val(TAM(0).Text) ' dX_Max

aX = OaX(FraX.Tag).Tag * 2 ' dX_T T pour Tétanos T

Xmin = aX - L_WS ' -dX_E <0 E pour End

X1 = aX / 2 ' Xup = dX_T/2 >0

X2 = -X1 ' X_T = -Xup <0

X3 = X1 - L_WS ' Xdown = - dX_T/2-dX_E = -(dW_Max+dX_E)/2

chi_p1 = 1 / Abs(X3) 'pente ss Vis Zone 1 = 2/(DXmin + DXmax)

KqnZ1 = Val(TAM(1).Text) '0.1 * 2 '0.25 - chi_p1 ' 0.033 * 3 'viscosité_MetZ_disjoints

a_q = Val(TAM(2).Text) 'pour Varaiation T / temp /rigor

b_q = Val(TAM(3).Text)

L_preWS = Val(TAM(4).Text)

N_hs = Val(TAM(5).Text) '5000

P_startF = Val(TAM(6).Text) 'coeff remontee max

dXz1 = Val(TAM(7).Text) 'pT Xa1 pour linéarisation de la parabolle zonze2 amorti

P_startS = Val(TAM(8).Text) 'coeff remontee max

to1_startS = Val(TAM(9).Text)

If dXz1 > 2 * Abs(Xmin) Then

 vd = MsgBox("Revoir valeur Xz1")

 TAM(7).Text = Format(Abs(Xmin))

 Exit Sub

End If

If Fresc.Tag = 0 Then '2016

 'chi_p2 = chi_p1 / 2 'pente ss Vis Zone 2 = 1/(DXmin + DXmax)

 X_Z1 = Xmin

Elseif Fresc.Tag = 1 Then '2019

 X_Z1 = -dXz1

```

'chi_p2 = (1 - chi_p1 * dXz1) / (L_WS - dXz1)
End If

chi_p2 = (1 + X_Z1 * chi_p1) / (L_WS + X_Z1)

'-----qZ1-----KqnZ1 = N_hs ^ (1 - qZ1 / 2) * coth[N_hs ^ (1 - qZ1 / 2)]
calcul_qoK (KqnZ1)
qZ1 = qOK
xmi = N_hs ^ (1 - qZ1 / 2)
cH_n = (Exp(xmi) + Exp(-xmi)) / 2
sH_n = (Exp(xmi) - Exp(-xmi)) / 2
z1_min = X_Z1 / KqnZ1
z1_max = z1_min * cH_n
Sigma_Vi_z1 = (KqnZ1 - 1) * chi_p1

'-----rZ2-----
rZ2 = qZ1 - Log(chi_p1 / chi_p2) / Log(N_hs)
xmi = N_hs ^ (1 - rZ2 / 2)
cH_n = (Exp(xmi) + Exp(-xmi)) / 2
sH_n = (Exp(xmi) - Exp(-xmi)) / 2
KrnZ2 = calcul_Kqn(rZ2)
z2_min = -L_WS / KrnZ2
z2_max = z2_min * cH_n
Ksi_Vi_z2 = (KrnZ2 - 1) * chi_p2
X_T0 = z2_min

vx = "X_hs (nm)"
vx = "X_hs (nm)"
xn = -L_WS - IIf(Fresc.Tag < 2, 2, 4)
xx = 5
xt = 1

'T0c=250'Kpa
If Frtyp.Tag = 1 Then
    impscale X0, Y0 + 130, X0 + larg, Y0 - 10 '14
    vy = "T(kPa)": yn = 0: yx = 500: yt = 50
Else
    impscale X0, Y0 + 130, X0 + larg, Y0 + 10 '14
    T0c = 1
    vy = "T/T0"
    yn = IIf(droites_Visco = 1, -0.8, -0.4) 'pour voir viscosité = -0.4 sino par défaut
    yx = 1.8: yt = 0.2
End If

O.DrawWidth = e_tt
impenvi_Xneg

'      fresc.tag=0      1      2      2
'.Caption = Choose(t + 1, "pT1 ", "pT1 tout", "pT2", "pT1+pT2")

-- trace ds points enregistrés ds table_T1T2
O.DrawMode = 13
N_fm = 0 'compteur de tracées

For t_arti = 0 To N_articles - 1
    If ChT1T2(t_arti) = 1 Then 'c'est ok
        'en 1 pour temp étudie ensemble à partir du T0 de 0°C
        z = ChT1T2(t_arti).Tag
        N_fm = N_fm + 1: zfm = z
        'les compléments
        T1T2met.Seek "=", z
        If T1T2met.NoMatch = 0 Then

```

```

AAPH_ARTNEG_Recalcul 'on part de T1c et de T2 puis on recacule tout ds pT1c et pT2
If Frtyp.Tag = 0 Then T0c = T0(0)
If IsNull(T1T2met("methode")) = 0 Then
    Select Case T1T2met("methode")
        Case "variation_T0": AAPH_ARTNEG_variation_T0 ("T0") 'qi = a + b *log(pT0i)
        Case "variation_tp1" 'on passe
        Case "rigor_vite_D": AAPH_ARTNEG_variation_T0 ("Rigor") 'AAPH_ARTNEG_RIGOR_D 'D pour Droites avec stepL
release et stretch rapides (< 0.2 ms)
        Case "rigor_stretch_lent_P": AAPH_ARTNEG_RIGOR_P 'P pour Parabole avec stretching lent (> 1 sec ie > plusiers
millers de ms)
        Case "variation_temp": AAPH_ARTNEG_variation_T0 ("temp") 'qi = a + b * pT0i ou exp ?
        Case Else: Stop
    End Select
End If
End If
'titre

T1T2.Seek "=", z, -99: If T1T2.NoMatch Then Stop
'titre = titre + Trim(T1T2("fm")) + " + "

'tracés des pts (surtout tout lasser ici) 'avec recalculs faits ds pT1c et pT2
O.DrawWidth = e_tt
O.DrawWidth = e_pt

'couleur
choix_coul = 1 'par defaut

'on personnlaise
Select Case zfm
Case 22 'ford 77
    choix_coul = 2
    bcol(10) = &H80FF& 'orange
    bcol(1) = &HFF00FF 'mauve
Case 1 'piazzesi 2002 +1995
    choix_coul = 2
    bcol(1) = QBColor(11) 'bleu ciel
    bcol(12) = &HFF00FF 'mauve
End Select

'bcol(10) = &H80FF& 'orange
'bcol(1) = QBColor(0) 'noir
'bcol(0) = qbcolor(1) 'bleu noir
'bcol(1) = QBColor(11) 'bleu ciel
'bcol(0) = &H808080 'gris
'bcol(2) = &HFF& 'rouge
'bcol(10) = &H80FF& 'orange
'bcol(12) = &HFF00FF 'mauve
'bcol(5) = &H8080& 'jaune foncé
'bcol(6) = &HFF& 'rouge

T1T2.MoveNext
Do While T1T2("cas") = z '10000 'z
    If Frpres.Tag <> 2 Then
        'pT1c ****
        If Fresc.Tag <> 2 And IsNull(T1T2("X1")) = 0 And IsNull(T1T2("pT1c")) = 0 Then
            xav = T1T2("X1"): yav = T1T2("pT1c") / 100
            xav = (xav - xn) * 100 / (xx - xn): yav = (yav - yn) * 100 / (yx - yn)
        If Fresc.Tag = 3 Then 'pT1+pT2
            O.PSet (xav, yav), QBColor(9)
        Elseif choix_coul <= 2 Then 'classqi
            O.PSet (xav, yav), QBColor(T1T2("coul_pt"))
        Else

```

```

coul = bcol(T1T2("coul_pt"))
O.PSet (xav, yav), coul
End If
End If

'pT2 ***
If Fresc.Tag > 1 And IsNull(T1T2("X2")) = 0 And IsNull(T1T2("pT2")) = 0 Then
  'If z = 1 Or z = 3 Then coul = QBColor(T1T2("cod_t2"))
  xav = T1T2("X2"): yav = T1T2("pT2") ' / 100
  xav = (xav - xn) * 100 / (xx - xn): yav = (yav - yn) * 100 / (yx - yn)
  If choix_coul = 2 Then
    coul = bcol(T1T2("coul_pt2"))
    O.PSet (xav, yav), coul
  Else
    O.PSet (xav, yav), QBColor(T1T2("coul_pt")) 'special pour T2 QBColor(T1T2("coul_pt2")) por avoir les pts 1995 et 1992
  End If
End If
*****
End If
T1T2.MoveNext: If T1T2.EOF Then Exit Do
Loop
End If
Next 'article

```

With O

```

'Fresc.tag = 0= unisqt ss VISCosité//1= uniqt av VISCosité // 2= 2 ss et av VISCosité
.DrawWidth = IIf(mmm = 1, 1, 3)
.FontSize = 12

```

If N_fm = 1 And (Frpres.Tag = 0 Or Frpres.Tag = 3) Then 'frpres.tag donne le type de representation de la figure que l'on veur
(legende pas legende etc)

```

T0c = IIf(Frtyp.Tag = 1, T0(0), 1)
'legende valeurs en X
xap = 5
yap = 11

```

```

For i = 0 To IIf(Fresc.Tag < 2, 11, 3)
  If i >= 6 And i <= 8 Then
    .ForeColor = QBColor(9)
  Elseif i > 8 Then
    .ForeColor = QBColor(11)
  Else
    .ForeColor = QBColor(0)
  End If

```

Select Case i

```

Case 0: xav = X3: tx1 = "X3": z = 7 - xap 'trait L_WS
Case 1: xav = Xmin: tx1 = "-dX_E": z = 7 - xap 'trait Xmin
Case 2: xav = -L_WS: tx1 = "-dX_Max": z = 7 - xap 'trait L_WS
Case 3: xav = -aX: tx1 = "-dX_T": z = 13 - xap 'trait ax
Case 4: xav = X_T0: tx1 = "X_T=0_z2": z = 10 - xap 'trait ax
Case 5: xav = -1 / (chi_p1 * KqnZ1): tx1 = "X_T0_Pente_z1": z = 15 - xap 'trait ax

```

```

'limite vraies zone 1 et vraie zone 2
Case 6: xav = X_Z1: tx1 = "Fin_z1": z = -40 - yap 'trait ax
Case 7: xav = z1_min: tx1 = "z1>z2": z = -36 - yap 'trait ax
Case 8: xav = z1_max: tx1 = "z2_tot": z = -35 - yap 'trait ax

```

```

Case 9: xav = -L_WS: tx1 = "Fin_z2": z = -40 - yap 'trait ax
Case 10: xav = z2_min: tx1 = "z2>s1": z = -30 - yap 'trait ax
Case 11: xav = z2_max: tx1 = "slack": z = -30 - yap 'trait ax
End Select
tx1 = tx1 + "=" + Format(xav, "##.##") + "nm"
If xav < xn Then xav = xn
xav = (xav - xn) * 100 / (xx - xn)
ymi = (-0.15 - yn) * 100 / (yx - yn)
.DrawStyle = IIf(i < 6, 2, 0)
O.Line (xav, ymi - z)-(xav, ymi + IIf(i = 1, 38, 5))
.CurrentX = xav - .TextWidth(tx1) * 0.5
.CurrentY = ymi - IIf(i < 6, z - 1, z - 2)
O.Print tx1

```

Next 'i

'legende valeur en Y ss viscosité

```

xav = Xmin: xav = (xav - xn) * 100 / (xx - xn)
yav = T0c * (1 + xav * chi_p1)
yap = (yav - yn) * 100 / (yx - yn)
xap = (1 - xn) * 100 / (xx - xn)
O.Line (xav, yap)-(xap, yap)
.CurrentX = xap + 0.2
.CurrentY = yap + 1
O.Print "pT = " + Format(yav, "0.####")

```

' If Fresc.Tag < 2 Then 'legende valeur en Y avec viscosite

```

' xav = Xmin: yav = T0c * (1 + xav * (chi_p1 * KqnZ1))
' xav = (xav - xn) * 100 / (xx - xn): yap = (yav - yn) * 100 / (yx - yn)
' O.Line (xav, yap)-(xap, yap)
' .CurrentX = xap + 0.2
' .CurrentY = yap + 1
' O.Print "pT = " + Format(yav, "0.####")
' End If

```

'legende en haut à gauche

For i = 1 To IIf(Fresc.Tag < 2, IIf(IsNull(T1T2met("methode")), 15, 12), 4)

Select Case i

```

Case 1: xav = chi_p1: tx1 = "pente_z1_ssV": k = 2      '1 color 2
Case 2: xav = chi_p2: tx1 = "pente_z2_ssV": k = 10     '2 color 10
Case 3: xav = chi_p1 * KqnZ1: tx1 = "pente_z1_avV": k = 1 '3 color 1
Case 4: xav = chi_p2 * KrnZ2: tx1 = "pente_z2_avV": k = 9 '4 color 9
Case 5: xav = qZ1: tx1 = "| q_z1": k = 12            '5 color 12
Case 6: xav = KqnZ1: tx1 = "<- Kqn": k = 12          '6 color 12
Case 7: xav = Sigma_Vi_z1: tx1 = "--> Sigma_z1": k = 12 '7 color 12
Case 8: xav = rZ2: tx1 = "V r_z2": k = 9             '8 color 9
Case 9: xav = KrnZ2: tx1 = "--> Krn": k = 9          '9 color 9
Case 10: xav = Ksi_Vi_z2: tx1 = "--> Ksi_z2": k = 9    '10 color 9
Case 11: xav = chi_p1 * N_hs ^ -qZ1 * 10000000: tx1 = "Nu_z1": k = 1 '11 color 1
Case 12: xav = chi_p2 * N_hs ^ -rZ2 * 10000000: tx1 = "Nu_z2": k = 9 '12 color 9
Case 13: xav = KqnZ1 * chi_p1: tx1 = "pT1_z1 = 1 +": k = 12 '13 color 12
Case 14: xav = chi_p2 * L_WS: tx1 = "pT1_z2": k = 9 '14 color 9
Case 15: xav = KrnZ2 * chi_p2: tx1 = " +": k = 9 '15 color 9

```

End Select

If i = 5 Or i = 8 Then 'q_z1 et r_z2

O.CurrentX = 20

ElseIf i = 6 Or i = 9 Or i = 13 Or i = 14 Then 'Kqn_z1 et Krn_z2 et Ksn_e3

O.CurrentX = 31

ElseIf i = 7 Or i = 10 Then 'Sigma_z1 et Ksi_z2 et Ksi_z3

```

O.CurrentX = 42.2
ElseIf i = 11 Or i = 12 Then 'nu
    O.CurrentX = 27
ElseIf i = 15 Then '
    O.CurrentX = 40
Else
    O.CurrentX = 45
End If

If i >= 5 And i <= 7 Then 'Visc z1
    O.CurrentY = 112 - 6 * 3
ElseIf i >= 8 And i <= 10 Then 'Vis_z2
    O.CurrentY = 112 - 7 * 3
ElseIf i = 11 Or i = 12 Then 'nu_z1 et nu_z2
    O.CurrentY = 112 - (i - 13) * 3
ElseIf i = 13 Then
    O.CurrentY = 87
ElseIf i > 13 Then
    O.CurrentY = 84 '5
Else
    O.CurrentY = 110 - i * 3
End If
O.ForeColor = QBColor(k)
If i < 5 Or i = 7 Or i = 10 Then
    tx1 = tx1 + " = " + Format(xav, "0.####") + " nm-1"
ElseIf i = 11 Or i = 12 Then
    tx1 = tx1 + " = " + Format(xav, "0.####") + " 10-7 nm-1"
ElseIf i = 13 Or i = 15 Then
    tx1 = tx1 + Format(xav, "0.####") + "*DX"
Else
    tx1 = tx1 + " = " + Format(xav, "0.####")
End If
O.Print tx1
Next 'i

```

End If

AAPH_ART_legende

'tracés droites de viscosité

```
'0="TOUT" 1="ART +DR_Visc +DR_Elast" 2="ART -DR_Visc +DR_Elast" 3="ART +DR_Visc -DR_Elast" 4="ART -DR_Visc -DR_Elast")
```

```
'      fresc.tag=0      1      2      2
'.Caption = Choose(t + 1, "pT1 ", "pT1 tout", "pT2", "pT1+pT2")
drap = 0
```

'tracés droites vetes elasticité

```
'0="TOUT" 1="ART +DR_Visc +DR_Elast" 2="ART -DR_Visc +DR_Elast" 3="ART +DR_Visc -DR_Elast" 4="ART -DR_Visc -DR_Elast")
```

"" AVEC droites vertes (ss Visc)

```
For i = IIf(Frpres.Tag <= 2, 1, 4) To IIf(droites_Visco = 1, 8, 6) '6
```

Select Case i 'TT =trat plein P=pointillé

'SS viscosité

Case 1 'TT zone 1 ss viscosité // pT=(1+0.15X)

```
yav = 1.8 * T0c: xav = (1.8 - 1) / (chi_p1)
```

```
xap = X_Z1: yap = T0c * (1 + xap * chi_p1) ' chi_p1 = Pente_ssV_Z1 = 1/abs(X3) = 0.15
coul = QBColor(2) 'trait epais vert foncé
```

Case 2 'P zone 1 ss viscosité// pT=(1+0.15X) : suite en pointille
 xav = X_Z1: yap = T0c * (1 + xav * chi_p1) ' il faut la terminer en pointille
 xap = X3: yap = 0
 coul = QBColor(0) 'pointillés noirs

Case 3 'TT zone 2 ss viscosité // pT= 0.075(10+X)
 xav = X_Z1: yap = T0c * (1 + xav * chi_p1) ' chi_p2 = chi_p1 /2 = 1/ (2*abs(X3))
 xap = -L_WS: yap = 0
 coul = QBColor(10) 'trait epais vert clair

'AV viscosité

Case 4 'TT zone 1 av viscosité // pT=(1+0.25X)
 xav = (1.8 - 1) / (chi_p1 * KqnZ1) '-z1_min ?
 yav = 1.8 * T0c
 xap = z1_min
 yap = T0c * (1 + xap * chi_p1 * KqnZ1) ' Pente_ssV_Z1 = chi_p1 + sigma_visc = 0.15 + 0.1 = 0.25

```
If yap < 0 Then xap = -1 / (chi_p1 * KqnZ1): yap = 0: drap = 1
If T1T2met("methode") = "variation_tp1" Then
  coul = &H80FF&  'orange QBColor(9) 'bleu
ElseIf zfm = 1 Then
  coul = QBColor(13) 'bleu
Else
  coul = QBColor(9) 'bleu
End If
```

Case 5 'P zone 1 av viscosité 'SUITE) // pT=(1+0.25X)
 'xav = Xmin 'avant
 xav = z1_min '2018
 yav = T0c * (1 + xav * chi_p1 * KqnZ1) ' il faut la terminer en pointille
 xap = -1 / (chi_p1 * KqnZ1): yap = 0
 coul = QBColor(0) 'pointillés noirs

Case 6 'TT zone 2 av viscosité // pT= 0.175(4.3+X)
 'X_T0 = Xmin - (1 + (chi_p1 + sigma_visc) * Xmin) / (chi_p2 + sigma_visc) '-4.3nm
 'xav = Xmin 'avant
 xav = z1_max
 yav = T0c * (Abs(X_T0) + xav) * chi_p2 * KrnZ2
 xap = X_T0: yap = 0
 If T1T2met("methode") = "variation_T0" Then
 coul = QBColor(9) 'bleu
 ElseIf T1T2met("methode") = "variation_tp1" Then
 coul = &H80FF& 'orange QBColor(9) 'bleu
 Else
 coul = QBColor(11) 'bleu clair
 End If

Case 7 'zone O que viscosité
 xav = -z1_min
 yav = T0c * chi_p1 * (KqnZ1 - 1) * xav
 'xap = Xmin 'avanr
 xap = X_Z1
 yap = T0c * chi_p1 * (KqnZ1 - 1) * xap
 coul = QBColor(12)

Case 8 'zone 2 que viscosité

```

xav = X_Z1
yav = T0c * chi_p2 * (KrnZ2 - 1) * xav

xap = -L_WS
yap = T0c * chi_p2 * (KrnZ2 - 1) * xap
coul = QBColor(12)

End Select

If xap < xav Then
    xav = (xav - xn) * 100 / (xx - xn); yav = (yav - yn) * 100 / (yx - yn)
    xap = (xap - xn) * 100 / (xx - xn); yap = (yap - yn) * 100 / (yx - yn)
    .DrawStyle = IIf(i = 2 Or i = 5, 2, 0)
    .DrawWidth = IIf(mmm = 1, 1, 3) * IIf(i = 2 Or i = 5, 1, 8)

    'coul = QBColor(Choose(i, 2, 0, 10, 9, 0, 11, 0))
    If Frpres.Tag = 0 Then
        O.Line (xav, yav)-(xap, yap), coul
    Elseif Frpres.Tag = 1 And i = 5 Then 'il faut la terminer en pointille de la droite ZONE 1
    'Elseif i = 5 Then 'si on veut le trait tout le temps
        O.Line (xav, yav)-(xap, yap), coul
    Elseif .DrawStyle = 0 And Fresc.Tag <> 2 Then
        O.Line (xav, yav)-(xap, yap), coul
    End If
End If

If drap = 1 Then Exit For
Next

*****LISSAGE entre ZONE 1 et ZONE2 2
If Fresc.Tag <> 2 Then
    .DrawWidth = 8
    xav = z1_min
    yav = T0c * (1 + xav * chi_p1 * KqnZ1)
    O.CurrentX = (xav - xn) * 100 / (xx - xn)
    O.CurrentY = (yav - yn) * 100 / (yx - yn)
    If T1T2met("methode") = "variation_T0" Then
        coul = QBColor(9) 'on reste en bleu clair
    Elseif T1T2met("methode") = "variation_tp1" Then
        coul = &H80FF& 'orange QBColor(9) 'bleu
    Elseif Fresc.Tag = 3 Then 'pT1+pT2
        coul = QBColor(9)
    Else
        coul = QBColor(13) 'ou 5 ou QBColor(IIf(xmi < X_Z1, 11, 9))
    End If
    For t = 1 To Np4
        xmi = z1_min + t * (z1_max - z1_min) / Np4
        If xmi < X_T0 Then
            Exit For
        End If
        yav = T0c * (1 + xmi * chi_p1 * KqnZ1)
        yap = T0c * chi_p2 * (L_WS + KrnZ2 * xmi)
        poids = t / Np4
        ymi = (1 - poids) * yav + poids * yap
        If ymi < 0 Then Exit For
        xap = (xmi - xn) * 100 / (xx - xn)
        yap = (ymi - yn) * 100 / (yx - yn)
        O.Line -(xap, yap), coul
    Next
End If

```

```

****ZONE parabole du mode Amorti interpolée linéairement
    fresc.tag=0      1      2      3
'.Caption = Choose(t + 1, "pT12017 ", "pT12018", "pT2", "pT1+pT2")
If Fresc.Tag = 1 And Frpres.Tag = 0 Then 'Or Fresc.Tag = 3
    .DrawStyle = 2
    .DrawWidth = 1
'P tracé parabole en pointille: pT1=(chi_p2/ax0*(L_WS+DX)^2
    'coul = QBColor(If(i = 1, 10, 2)) 'vert clair // vert foncé
    xav = Xmin
    yav = (L_WS + xav) ^ 2 / (2 * Abs(X3) * aX) 'pT=(L_WS+X)^2/(2*ax*abs(X3))
    yav = T0c * yav
    .CurrentX = (xav - xn) * 100 / (xx - xn)
    .CurrentY = (yav - yn) * 100 / (yx - yn)
For t = 1 To Np4
    xap = Xmin - t * (Xmin + L_WS) / Np4
    yap = (L_WS + xap) ^ 2 / (2 * Abs(X3) * aX)
    yap = T0c * yap
    If yap <= 0 Then Exit For
    xap = (xap - xn) * 100 / (xx - xn): yap = (yap - yn) * 100 / (yx - yn)
    O.Line -(xap, yap), QBColor(13) 'jaunefoncé
Next
End If

r_HelA = 0 'sert à laire la moyenne des r2
If N_fm = 1 And Fresc.Tag <= 1 Then 'T1 ----- reg T1

    Debug.Print "Controle", Format(T0(nSM)) + " kPa", "Bz1_min = "; z1_min, "Bz1_max = "; z1_max, "Bz2_min = "; z2_min,
    "Bz2_max = "; z2_max

    Pds = z1_max 'normal
    If z2_min > z1_max Then Pds = z2_min

    T1T2.Seek "=", zfm, 1: If T1T2.NoMatch Then Stop
    T0_CC = T0c
    sN = 0: sX = 0: sXX = 0: sY = 0: sYY = 0: sXY = 0
    nSM = T1T2("cod_T1"): coul = QBColor(T1T2("coul_pt"))
    'pente instannée
    AAPH_ARTNEG_variation_T0_chi_i nSM

Do While T1T2("cas") = zfm
    If T1T2("cod_T1") > nSM Then 'on chnde droite
        ' If T1T2met("methode") <> "variation_T0" Then Stop 'petit verif
        'on écrit la régression
        AAPH_ARTNEG_trace_R2 "T1"
        'il faut tout recalculer
        qOK = a_q + b_q * Log(T0(nSM) / T0(0))
        KqnZ1 = calcul_Kqn(qOK)
        xmi = N_hs ^ (1 - qOK / 2)
        cH_n = (Exp(xmi) + Exp(-xmi)) / 2
        sH_n = (Exp(xmi) - Exp(-xmi)) / 2
        z1_min = X_Z1 / KqnZ1
        z1_max = z1_min * cH_n

    'pente instannée
    AAPH_ARTNEG_variation_T0_chi_i nSM
    r = qOK + Log(chi_p2_i / chi_p1_i) / Log(N_hs)
    KrnZ2 = calcul_Kqn(r)
    xmi = N_hs ^ (1 - r / 2)
    cH_n = (Exp(xmi) + Exp(-xmi)) / 2
    sH_n = (Exp(xmi) - Exp(-xmi)) / 2
    z2_min = -L_WS / KrnZ2

```

```

z2_max = z2_min * cH_n
Pds = z1_max 'normal
If z2_min > z1_max Then Pds = z2_min

'on repart de zéro
T0_CC = IIf(Frtyp.Tag = 1, T0(nSM), T0(nSM) / T0(0))
sN = 0: sX = 0: sXX = 0: sY = 0: sYY = 0: sXY = 0
nSM = T1T2("cod_T1"): coul = QBColor(T1T2("coul_pt"))
End If

If IsNull(T1T2("X1")) = 0 And IsNull(T1T2("pT1c")) = 0 Then
    xav = T1T2("X1"): yav = T1T2("pT1c")
    drap = 1
    If T1T2("cas") = 5 And T1T2("pt") = 22 And T1T2("cod_T1") = 5 Then z1_min = 2
    'If T1T2("cas") = 7 And T1T2("pt") = 12 And T1T2("cod_T1") = 3 Then z1_min = 2
    'If T1T2("cas") = 8 And T1T2("pt") = 19 And T1T2("cod_T1") = 4 Then z1_min = 2
    If T1T2("cas") = 9 And T1T2("pt") = 12 And T1T2("cod_T1") = 3 Then z1_min = 2
    If T1T2("cas") = 28 And T1T2("pt") = 27 And T1T2("cod_T1") = 3 Then z1_min = 2
    If xav > Abs(z1_min) Or yav < 0 Then 'hors zone
        drap = 0
    Elseif xav <= Abs(z1_min) And xav > z1_min Then 'zone 1 VRAIE
        yap = T0_CC * (1 + xav * chi_p1_i * KqnZ1)
    Elseif xav > Pds Then 'zone mixte
        xmi = T0_CC * (1 + xav * chi_p1_i * KqnZ1)
        ymi = T0_CC * chi_p2_i * (L_WS + KrnZ2 * xav)
        poids = (xav - z1_min) / (z1_max - z1_min) ' t / Np4 ' xmi = z1_min + t * (z1_max - z1_min) / Np4
        yap = (1 - poids) * xmi + poids * ymi
    Elseif Pds = z1_max And xav > z2_min Then 'zone 2 vraie
        'petite verif
        'If xav < X_T0 Then Stop ' a verifier
        yap = T0_CC * (Abs(X_T0) + xav) * chi_p2_i * KrnZ2
    Else
        yap = 0
        'drap = 0
    End If
    If drap = 1 Then 'OK
        'If T1T2("cod_T1") = 5 Then Debug.Print xav, yav, yap
        T1T2.Edit: T1T2("pT1t") = yap: T1T2.Update
        sN = sN + 1
        sX = sX + yav: sXX = sXX + yav ^ 2
        sY = sY + yap: sYY = sYY + yap ^ 2
        sXY = sXY + yav * yap
    End If
End If
T1T2.MoveNext: If T1T2.EOF Then Exit Do
Loop
AAPH_ARTNEG_trace_R2 "T1"

End If

End With
End Sub

```

Sub AAPH_ARTNEG_Recalcul() 'recalcul en fonction du typ choisi

```
Dim z_coD As Integer, z_X1 As Single
**** Informations recueillies ds T1T2met
'T1T2met.Seek "=", z: If T1T2met.NoMatch Then Stop
N_droites = T1T2met("N_facteur")
For i = 0 To N_droites - 1
    vd = "T0" + If(i = 0, "c", "m" + Format(i))
    If IsNull(T1T2met(vd)) Then Stop
    If T1T2met(vd) = 0 And z <> 703 Then Stop
    T0(i) = T1T2met(vd)
Next

**** On travaille T1T2
'index=PK =cas + pt
T1T2.Seek "=", z, -99: If T1T2.NoMatch Then Stop

If IsNull(T1T2("cod_T1")) Then
    T1_pT = 0
Else
    T1_pT = T1T2("cod_T1")
End If

If IsNull(T1T2("cod_T2")) Then
    T2_pT = 0
Else
    T2_pT = T1T2("cod_T2")
End If

T1T2.Seek "=", z, 1: If T1T2.NoMatch Then Stop
z_coD = T1T2("cod_T1"): If z_coD <> 1 And zfm <> 19 And zfm <> 11 Then Stop 'verif
sN = 0: sX = 0: sXX = 0: sY = 0: sYY = 0: sXY = 0

Do While T1T2("cas") = z

    T1T2.Edit
    If T1_pT > 0 Then
        If IsNull(T1T2("X1")) = 0 And IsNull(T1T2("T1c")) = 0 And T1T2("cod_T1") > 0 Then
            Select Case Frtyp.Tag
                Case 1: T1T2("pT1c") = T1T2("T1c") ' T1 en kPa
                Case 2: T1T2("pT1c") = T1T2("T1c") / T0(0) ' pT1 calculé sur TOc
                Case 3: T1T2("pT1c") = T1T2("T1c") / T0(T1T2("cod_T1") - 1) ' pT1 calculé sur TOm
            End Select
            z_X1 = T1T2("X1")
            If IsNull(T1T2("cod_T1")) = 0 And T1T2("cod_T1") > z_coD Then 'on change de Droite donc on EnRegistre
                If sN < 2 Then Stop
                'r
                r_regL = (sXY - sX * sY / sN) / Sqr((sXX - sX * sX / sN) * (sYY - sY * sY / sN))
                If r_regL < 0.8 Or r_regL > 1.00001 Then Stop
                'pente
                p_regL = (sXY - sX * sY / sN) / (sXX - sX * sX / sN)
                If p_regL < 0 Then Stop
                'ordonné à l'origine
                Y0_regL = sY / sN - p_regL * sX / sN
                'pente visoc
                p_regL = p_regL / T0(z_coD - 1) '/T0(0) car car calculé à partir de ymi = T1T2("T1c") (voir plus bas)
                Y0_regL = Y0_regL / T0(z_coD - 1)
                If (p_regL - chi_p1) <= 0 Then
                    qOK = 2.5
                Else
                    Kqn = p_regL / chi_p1 'T1i/T0i=1+(Chi_p1+Sigma_i)*DX
                    calcul_qoK (Kqn)
                End If
            End If
        End If
    End If
End Do
```

```

'on enregistre
T1T2met.Edit
    tx1 = "_" + IIf(z_coD = 1, "c", "m" + Format(z_coD - 1))
    T1T2met("p" + tx1) = p_regL * T1i/T0i=1+(Chi_p1+Sigma_i)*DX
    T1T2met("Y0" + tx1) = Y0_regL
    T1T2met("r2" + tx1) = r_regL ^ 2
    T1T2met("q" + tx1) = qOK
    T1T2met("nu" + tx1) = chi_p1 * N_hs ^ -qOK * 10000000
T1T2met.Update
'et on repart
z_coD = T1T2("cod_T1") 'en kpa
sN = 0: sX = 0: sXX = 0: sY = 0: sYY = 0: sXY = 0
End If
If z_X1 >= Xmin And z_X1 <= 0 Then
    ymi = T1T2("T1c")
    sN = sN + 1
    sX = sX + z_X1: sXX = sXX + z_X1 ^ 2
    sY = sY + ymi: sYY = sYY + ymi ^ 2
    sXY = sXY + z_X1 * ymi
End If
End If
End If
If T2_pT > 0 Then
    If IsNull(T1T2("T2")) = 0 And T1T2("cod_T2") > 0 Then
        Select Case Frtyp.Tag
            Case 1: T1T2("pT2") = T1T2("T2") ' T2 en kPa
            Case 2: T1T2("pT2") = T1T2("T2") / T0(0) ' pT2 calculé sur TOc
            Case 3: T1T2("pT2") = T1T2("T2") / T0(T1T2("cod_T2") - 1) ' pT2 calculé sur TOM
        End Select
    End If
End If
T1T2.Update
T1T2.MoveNext
Loop
*****
If sN > 1 Then
    'r
    r_regL = (sXY - sX * sY / sN) / Sqr((sXX - sX * sX / sN) * (sYY - sY * sY / sN))
    'pente
    p_regL = (sXY - sX * sY / sN) / (sXX - sX * sX / sN)
    'ordonné à l'origine
    Y0_regL = sY / sN - p_regL * sX / sN
    p_regL = p_regL / T0(z_coD - 1)
    Y0_regL = Y0_regL / T0(z_coD - 1)
    If (p_regL - chi_p1) <= 0 Then 'pas de viscosité
        qOK = 2.5
    Else
        Kqn = p_regL / chi_p1
        calcul_qOK (Kqn) '1 / 8.01 * Log(2800000 / Kqn) '1.9
    End If
    'on enregistre
    T1T2met.Edit
        tx1 = "_" + IIf(z_coD = 1, "c", "m" + Format(z_coD - 1))
        T1T2met("p" + tx1) = p_regL
        T1T2met("Y0" + tx1) = Y0_regL
        T1T2met("r2" + tx1) = r_regL ^ 2
        T1T2met("q" + tx1) = qOK
        T1T2met("nu" + tx1) = chi_p1 * N_hs ^ -qOK * 10000000
    T1T2met.Update
End If
End Sub

```

Sub AAPH_ARTNEG_variation_T0(iX As String)

```
Dim ZONE As Integer, leg As Integer, ztx As String, cH_i As Single, sH_i As Single, Bz1_min As Single, Bz1_max As Single, Bz2_min As Single
Dim Bpoids As Single, Super_theoriq As Integer
If zfm = 11 Or zfm = 19 Or zfm = 22 Then Exit Sub
If Fresc.Tag = 2 And Frpres.Tag = 4 Then Exit Sub 'uniqt T2
If N_droites = 1 Then Exit Sub
If N_droites < 1 Then Stop
If zfm = 3 Or zfm = 4 Then
    Select Case zfm
        Case 3 'Ford 81 F6
            T0(1) = T0(0) * (2.607 - 0.7143 * 2.6)
            T0(2) = T0(0) * (2.607 - 0.7143 * 3.1)
        Case 4 'Ford 81 F11
            T0(1) = T0(0) * (2.607 - 0.7143 * 3.1)
    End Select
Else
    Super_theoriq = 0 'normal on part sur les T0 mesurées
End If

If Super_theoriq = 1000 Then
    Select Case zfm
        Case 3 'Ford 81 F6
            T0(1) = T0(0) * (2.607 - 0.7143 * 2.6)
            T0(2) = T0(0) * (2.607 - 0.7143 * 3.1)
        Case 4 'Ford 81 F11
            T0(1) = T0(0) * (2.607 - 0.7143 * 3.1)
        Case 5 'Linai 2003 pCa slow fibre
            For i = 1 To 4
                xmi = Choose(i, 5.3, 5.49, 5.63, 5.84)
                ' q = Choose(i + 1, 4.5, 5.3, 5.49, 5.63, 5.84)
                Debug.Print "i= "; i
                Debug.Print "Avant : T0i = "; T0(i)
                T0(i) = T0(0) * (1 - 1 / (1 + Exp(30.5 - 5.5 * xmi))) ' a = 30.5: b = 5.5 'OK1
                'T0(i) = T0(0) * (1 - 1 / (1 + Exp(13.685 - 2.4452 * xmi)))
                Debug.Print "Après : T0i = "; T0(i)
            Next
        Case 6 'Linai 2003 pCa
    End Select
End If

' 1 : on cherche la relation q_i = a_q + b_q * log(pT_i)
sN = 0: sX = 0: sXX = 0: sY = 0: sYY = 0: sXY = 0
For i = 0 To N_droites - 1 'la 1ere droites C=0
    tx1 = IIf(i = 0, "c", "m" + Format(i))
    Select Case iX
        Case "T0": xmi = Log(T0(i) / T0(0)): ztx = " * Log(pT0_i)"
        Case "temp2": xmi = Exp(T0(i) / T0(0)): ztx = " * exp(pT0_i)"
        Case "temp", "Rigor": xmi = T0(i) / T0(0): ztx = " * pT0_i"
    Case Else: Stop 'a faire
    End Select
    ymi = T1T2met("q_" + tx1)
    sN = sN + 1
    sX = sX + xmi: sXX = sXX + xmi ^ 2
    sY = sY + ymi: sYY = sYY + ymi ^ 2
    sXY = sXY + xmi * ymi
Next 'i

'regression q = a_q + b_q * log(T0i/T0c)
If sN = 2 Then
    r_regL = 1: p_regL = 1
```

```

Else
'r
r_regL = (sXY - sX * sY / sN) / Sqr((sXX - sX * sX / sN) * (sYY - sY * sY / sN))
'pente
p_regL = (sXY - sX * sY / sN) / (sXX - sX * sX / sN)
End If
'ordonné à l'origine
Y0_regL = sY / sN - p_regL * sX / sN

```

'2: on stocke

```

T1T2met.Edit
T1T2met("r2_q_REG") = r_regL ^ 2
T1T2met("a_q_REG") = Y0_regL
T1T2met("b_q_REG") = p_regL
If Trim(TAM(3).Text) = "0.1" And Trim(TAM(2).Text) = "1.9" Then
    Stop 'à verifier ce truc 2019
    T1T2met("a_q_main") = Y0_regL: a_q = Y0_regL: TAM(2).Text = Format(a_q, "#.###")
    T1T2met("b_q_main") = p_regL: b_q = p_regL: TAM(3).Text = Format(b_q, "0.###")
End If
T1T2met.Update

```

'3 on trace

With O

.FontBold = -1

'relatopn q en fonction de log(pTi)

```

If N_hs > 0 Then
    O.FontSize = 12: O.CurrentX = 20: O.CurrentY = 88
    O.Print "THEOR.: q_i = " + Format(Y0_regL, "#.###") + " + " + Format(1 / Log(N_hs), "0.###") + ztx
    O.FontSize = 8: O.CurrentX = 46: O.CurrentY = 88
    O.Print "b_q = 1/log(N_hs)"
End If

```

```

O.FontSize = 12: O.CurrentX = 20: O.CurrentY = 85
O.Print "REGR. : q_i = " + Format(Y0_regL, "#.###") + " + " + Format(p_regL, "0.###") + ztx
O.FontSize = 8: O.CurrentX = 46: O.CurrentY = 85
O.Print "PAS SE FOCALISER car regression calculée"
O.CurrentX = 46: O.CurrentY = 84
O.Print "à partir des 2/3 pts entre 0 et -DXend"
O.FontSize = 12: O.CurrentX = 20: O.CurrentY = 82
O.Print "STOCKé : q_i = " + Format(a_q, "#.###") + " + " + Format(b_q, "0.###") + ztx

```

For i = 0 To N_droites - 1 'la 1ere droites C=0 deja tracée

```

.DrawWidth = IIf(i = 0, 1, 6)
.DrawStyle = IIf(i = 0, 2, 0)

```

ZONE = 1

'point haut' A ce stade a_q=a_q_main b_q=b_q_main

```

Select Case iX
    Case "T0": qOK = a_q + b_q * Log(T0(i) / T0(0))
    Case "temp2": qOK = a_q + b_q * Exp(T0(i) / T0(0))
    Case "temp", "Rigor": qOK = a_q + b_q * T0(i) / T0(0)
    Case Else: Stop 'a faire
End Select

```

```

Kqn = calcul_Kqn(qOK)
xmi = N_hs ^ (1 - qOK / 2)
cH_i = (Exp(xmi) + Exp(-xmi)) / 2
sH_i = (Exp(xmi) - Exp(-xmi)) / 2
Bz1_min = X_Z1 / Kqn
Bz1_max = Bz1_min * cH_i

```

'Pente instantanée*****

AAPH_ARTNEG_variation_T0_chi_i

```
D = chi_p1_i * Kqn  
  
Select Case Frtyp.Tag  
Case 1: xav = 1 / D ' T1m= T0m*[1+D* X]  
Case 2: xav = (2 * T0(0) / T0(i) - 1) / D ' pT1m= Tm/T0c= T0m/T0c *[1+D* X]  
Case 3: xav = 1 / D ' pT1m=Tm/T0m= [1+D* X] '=(2 - 1) / D  
End Select  
yav = 2 * IIf(Frtyp.Tag = 1, T0(i), 1) '* T0c '1.5 '=PT1c
```

```
'point bas  
xap = -1 / D  
yap = 0  
  
xap = Bz1_min  
ymi = 1 + chi_p1_i * Kqn * xap  
Select Case Frtyp.Tag  
Case 1: yap = T0(i) * ymi ' T1m= T0m*[1+D* X]  
Case 2: yap = ymi * T0(i) / T0(0) ' pT1m= Tm/T0c= T0m/T0c *[1+D* X]  
Case 3: yap = ymi ' pT1m=Tm/T0m= [1+D* X]  
End Select
```

AAPH_ARTNEG_var_choix_couleur

```
xav = (xav - xn) * 100 / (xx - xn)  
yav = (yav - yn) * 100 / (yx - yn)  
xap = (xap - xn) * 100 / (xx - xn)  
yap = (yap - yn) * 100 / (yx - yn)  
O.Line (xav, yav)-(xap, yap), coul
```

```
*****légende ZONE 1  
If Frpres.Tag = 0 Then  
'legende en haut à gauche  
.FontSize = 10  
For leg = 0 To 4 'IIf(Ix = "T0", 6, 4) 'IIf(Fresc.Tag = 0, 10, 4)  
xmi = 9  
Select Case leg  
Case 0: tx1 = "droite " + IIf(i = 0, "REF", Format(i)): O.CurrentX = xmi  
Case 1: xav = T0(i) / T0(0): tx1 = "pT0_i": O.CurrentX = xmi + 6  
Case 2: xav = qOK: tx1 = "q_i": O.CurrentX = xmi + 14  
Case 3: xav = Kqn: tx1 = "Kqn_i": O.CurrentX = xmi + 20  
Case 4: xav = Kqn * chi_p1_i: tx1 = "pT1_z1=1+": O.CurrentX = xmi + 27.5  
End Select
```

```
O.CurrentY = 78 - i * 3  
  
O.ForeColor = coul 'QBColor(Choose(i, 2, 10, 1, 9, 12, 12, 12, 9, 9, 9, 6, 6, 13, 0, 0))  
If leg = 0 Then  
O.Print tx1  
Else  
If leg = 4 Then  
tx1 = tx1 + Format(xav, "0.###") + "DX"  
Else  
tx1 = tx1 + " = " + Format(xav, "0.###")  
End If  
O.Print tx1  
End If  
Next 'leg  
End If
```

```

*****  

r = qOK + Log(chi_p2_i / chi_p1_i) / Log(N_hs)  

Krn = calcul_Kqn(r)  

Bz2_min = -L_WS / Krn ': If Bz2_min > X_Z1 Then Stop 'pas normal  

If Bz2_min < Bz1_max Then 'zone 2 Vraie  

**legende zone 2  

If Frpres.Tag = 0 Then  

For leg = 0 To 3 'If(Fresc.Tag = 0, 10, 4)  

xmi = 47  

Select Case leg  

Case 0: xav = r: tx1 = "r_i": O.CurrentX = xmi  

Case 1: xav = Krn: tx1 = "Krn_i": O.CurrentX = xmi + 5.5  

Case 2: xav = chi_p2_i * L_WS: tx1 = "pT1_z2": O.CurrentX = xmi + 12.5  

Case 3: xav = Krn * chi_p2_i: tx1 = "+": O.CurrentX = xmi + 20  

End Select  

O.CurrentY = 78 - i * 3  

O.ForeColor = coul 'QBColor(Choose(i, 2, 10, 1, 9, 12, 12, 12, 9, 9, 9, 6, 6, 13, 0, 0))  

If leg = 3 Then  

tx1 = tx1 + Format(xav, "0.###") + "*DX"  

Else  

tx1 = tx1 + " = " + Format(xav, "0.###")  

End If  

O.Print tx1  

Next 'leg  

End If  

'vraie zone 2 avec X_T0 = -L_WS / KrnZ2 < 0  

xav = Bz1_max  

yav = chi_p2_i * L_WS + xav * chi_p2_i * Krn  

Select Case Frtyp.Tag  

Case 1: yav = T0(i) * yav ' T1m= T0m*[1+D* X]  

Case 2: yav = yav * T0(i) / T0(0) ' pT1m= Tm/T0c= T0m/T0c *[1+D* X]  

Case 3: 'OK ' pT1m=Tm/T0m= [1+D* X]  

End Select  

xap = Bz2_min: yap = 0  

xav = (xav - xn) * 100 / (xx - xn)  

yav = (yav - yn) * 100 / (yx - yn)  

xap = (xap - xn) * 100 / (xx - xn)  

yap = (yap - yn) * 100 / (yx - yn)  

O.Line (xav, yav)-(xap, yap), coul  

End If  

*** lissage entre zone 1 et zone 2  

xav = Bz1_min 'Fin zone 1vraie  

yav = (1 + xav * chi_p1_i * Kqn)  

Select Case Frtyp.Tag  

Case 1: yav = T0(i) * yav ' T1m= T0m*[1+D* X]  

Case 2: yav = yav * T0(i) / T0(0) ' pT1m= Tm/T0c= T0m/T0c *[1+D* X]  

Case 3: 'OK ' pT1m=Tm/T0m= [1+D* X]  

End Select  

O.CurrentX = (xav - xn) * 100 / (xx - xn)  

O.CurrentY = (yav - yn) * 100 / (yx - yn)  

For t = 1 To Np4  

xmi = Bz1_min + t * (Bz1_max - Bz1_min) / Np4  

'If xmi < -L_WS / Krn Then 'X_T=0

```

```

If xmi < Bz2_min Then 'X_T=0
    Exit For
End If
yav = (1 + xmi * chi_p1_i * Kqn)
'yap = (L_WS / Krn + xmi) * chi_p2 * Krn
yap = (Abs(Bz2_min) + xmi) * chi_p2_i * Krn
Bpoids = t / Np4
ymi = (1 - Bpoids) * yav + Bpoids * yap

Select Case Frtyp.Tag
Case 1: yap = T0(i) * ymi ' T1m= T0m*[1+D* X]
Case 2: yap = ymi * T0(i) / T0(0) ' pT1m'= Tm/T0c= T0m/T0c *[1+D* X]
Case 3: yap = ymi ' pT1m=Tm/T0m= [1+D* X]
End Select

xap = (xmi - xn) * 100 / (xx - xn)
yap = (yap - yn) * 100 / (yx - yn)
O.Line -(xap, yap), coul ', QBColor(IIf(xmi < X_z1, 11, 9))
Next
Next

End With
'T0c = 1
End Sub

```

Sub calcul_qoK(Kx As Single)

```
Dim Res As Single, siGne As Integer, siGne2 As Integer, qA As Single, qB As Single, qC As Single, qD As Single, t_q As Integer
If Kx < 1 Then Stop
If Kx = 1 Then qOK = 3: Exit Sub 'pas de viscosité
Res = 0.0002 'résoluton/erreur min
qOK = (1 / 8.01) * Log(2700000 / (Kx - 1))
xmi = N_hs ^ (1 - qOK / 2)
Kqn = xmi * (Exp(2 * xmi) + 1) / (Exp(2 * xmi) - 1) + (1 / N_hs) ^ (qOK - 1)
drap = 0
'etape 1
If Abs(Kqn - Kx) > Res Then 'on cherche
    siGne = IIf(Kqn > Kx, 1, -1)
    For t_q = 1 To 100
        yap = qOK + siGne * t_q / 10
        Kqn = calcul_Kqn(yap)
        If Abs(Kqn - Kx) <= Res Then qOK = yap: drap = 10: Exit For 'on cherche
        siGne2 = IIf(Kqn > Kx, 1, -1)
        If siGne2 <> siGne Then drap = 1: qA = qOK + siGne * (t_q - 1) / 10: Exit For
    Next
    If drap = 0 Then Stop
    If drap = 1 Then
        For t_q = 0 To 100
            yap = qA + siGne * t_q / 100
            Kqn = calcul_Kqn(yap)
            If Abs(Kqn - Kx) <= Res Then qOK = yap: drap = 10: Exit For 'on cherche
            siGne2 = IIf(Kqn > Kx, 1, -1)
            If siGne2 <> siGne Then drap = 2: qB = qA + siGne * (t_q - 1) / 100: Exit For
        Next
        If drap < 2 Then Stop
        If drap = 2 Then
            For t_q = 0 To 100
                yap = qB + siGne * t_q / 1000
                Kqn = calcul_Kqn(yap)
                If Abs(Kqn - Kx) <= Res Then qOK = yap: drap = 10: Exit For 'on cherche
                siGne2 = IIf(Kqn > Kx, 1, -1)
                If siGne2 <> siGne Then drap = 3: qC = qB + siGne * (t_q - 1) / 1000:: Exit For
            Next
            If drap < 3 Then Stop
            If drap = 3 Then
                For t_q = 0 To 100
                    yap = qC + siGne * t_q / 10000
                    Kqn = calcul_Kqn(yap)
                    If Abs(Kqn - Kx) <= Res Then qOK = yap: drap = 10: Exit For 'on cherche
                    siGne2 = IIf(Kqn > Kx, 1, -1)
                    If siGne2 <> siGne Then drap = 4: qD = qC + siGne * (t_q - 1) / 1000:: Exit For
                Next
            End If
        End If
        End If
        End If
    'derniere verif
    xmi = N_hs ^ (1 - qOK / 2)
    Kqn = xmi * (Exp(2 * xmi) + 1) / (Exp(2 * xmi) - 1) + (1 / N_hs) ^ (qOK - 1) '- 1
    If Abs(Kqn - Kx) > Res Then Stop
End Sub
```

Function calcul_Kqn(zq As Single) As Single

```
If N_hs < 500 Then Stop 'bizarre_ surement un oubli
If zq < 0.7 Then
    Stop
    calcul_Kqn = 10
Else
    ymi = N_hs ^ (1 - zq / 2)
    calcul_Kqn = ymi * (Exp(2 * ymi) + 1) / (Exp(2 * ymi) - 1) + N_hs ^ (1 - zq)
End If
End Function
```

Sub AAPH_ARTNEG_variation_T0_chi_i(iX As Integer)

chi_p1_i = chi_p1 'par défaut
chi_p2_i = chi_p2 'par défaut

If Fresc.Tag = 1 And (zfm = 16 Or zfm = 17 Or zfm = 18) Then '2019

bo1_pT = 9: bo2_pT = 0.5 '0.6

dX_Ti = L_WS + (aX - L_WS) / (1 + Exp(-bo1_pT * (T0(iX) / T0(0) - bo2_pT)))

chi_p1_i = 1 / (L_WS - dX_Ti / 2)

chi_p2_i = (1 + X_Z1 * chi_p1_i) / (L_WS + X_Z1)

End If

End Sub

Sub AAPH_ARTNEG_var_choix_couleur()

```
'Jaune vif &H0000FFFF&
'Jaune foncé : &H0000C0C0&
'Orange clair : &H0080C0FF&
'Orange : &H000080FF&
'Rose : &H00FF80FF&
'Rose 2: &H00C0C0FF&
'Rose 3: &H008080FF&
'Bordeaux : &H000000C0&
'Vert clair : &H00C0FFC0&
'Vert : &H0000FF00&
'Vert foncé : &H0000C000&
'Bleu clair : &H00FFFC0&
'Bleu clair 2 : &H00FFFF80&Gris: &H00C0C0C0&
'Bleu cile : &H00FFFF00&
'Bleu gris : &H00C0C000&
'Bleu roi : &H00C00000&
'Violet pale : &H00FFC0C0&
'Mauve intense
'Gris foncé : &H00808080&
```

```
'coul = QBColor(Choose(i, 11, 3, 13, 4, 10, 6))
Select Case zfm
Case 3 'Foe 81 F3 L0s'
'Ford 81 F6 et F11
    coul = QBColor(Choose(i + 1, 0, 12, 13)) 'Ford 81 fig 11
Case 4: coul = QBColor(Choose(i + 1, 0, 11)) 'Ford 81 fig 11
'Linari 32003 pCa Fig 9C et
Case 5: coul = QBColor(Choose(i + 1, 0, 12, 13, 5, 3, 10, 6)) 'mauve clair + mauve foncé + bleu+ bleu canard
Case 6: coul = QBColor(Choose(i + 1, 0, 13, 5, 3, 10, 6)) 'mauve clair + mauve foncé + bleu canard
```

```
Case 8: coul = QBColor(Choose(i + 1, 0, 12, 13, 10))
Case 9, 12: coul = QBColor(Choose(i + 1, 0, 12, 10))
Case 15, 21, 24: coul = QBColor(Choose(i + 1, 0, 12, 10, 4)) 'R ESCUL piazzesi
```

```
'FORD 85
Case 16, 17, 18: coul = QBColor(Choose(i + 1, 0, 11, 13, 4, 12)) 'bleu ciel /mauve clair/marron/rouge
```

```
'tasatryan 99
Case 26: coul = QBColor(Choose(i + 1, 0, 6, 10, 6))
```

```
Case 703: coul = QBColor(Choose(i + 1, 0, 10, 12, 10, 4))
Case Else: coul = QBColor(Choose(i + 1, 1, 12, 13, 11, 4, 13, 10))
End Select
End Sub
```

Sub AAPH_ART_legende()

```
Dim titre As String
"ph12_NEG_pT", "ph12_STRAIN", "ph12_RIGOR_pT", "ph12_TEMP_pT"
Select Case ressort.Tag
Case "ph12_NEG_pT": k = 0
Case "ph12_STRAIN"
    Select Case TE
        Case "Divers": k = 500
        Case "Edman": k = 1100
        Case "Lapin": k = 1200
        Case Else: Stop
    End Select
Case "ph12_RIGOR_pT": k = 0
Case "ph12_TEMP_pT": k = 0
Case Else: Stop
End Select

T1T2met.Index = "PK"
z = 0
titre = ""
For i = 0 To 30
    If ChT1T2(i) = 1 Then
        t = i: z = z + 1 'c'est ok
        T1T2met.Seek "=", ChT1T2(i).Tag + k
        If T1T2.NoMatch Then Stop
        titre = titre + Trim(T1T2met("fm")) + " + "
    End If
Next
'titre
O.FontSize = 18
O.CurrentX = -3
O.CurrentY = 110
O.ForeColor = QBColor(0)
O.Print titre
If z <> 1 Then Exit Sub
N_fm = 1

O.FontBold = -1
O.FontSize = 12
If N_fm = 1 Then '1 seule fibre donc on donne cses caracteritiques
    For i = 1 To 11
        tx1 = ""
        Select Case i
            Case 1
                If IsNull(T1T2met("methode")) = 0 Then
                    tx1 = T1T2met("methode")
                Elseif IsNull(T1T2met("facteur")) = 0 Then
                    tx1 = tx1 + " (" + T1T2met("facteur") + ")"
                End If
            Case 2: If IsNull(T1T2met("comm")) = 0 Then tx1 = T1T2met("comm")
            Case 3: tx1 = "NFig : " + T1T2met("n o_Fig")
            Case 4: tx1 = T1T2met("typ_step")
            Case 5: tx1 = T1T2met("l_Espece") + " (" + T1T2met("l_Musc") + ")"
            Case 6: If IsNull(T1T2met("du_p1")) = 0 Then tx1 = "durée Phase 1 = " + T1T2met("du_p1") + " µs"
            Case 7: tx1 = "T°exp. = " + T1T2met("Texp") + " °C"
            Case 8: If IsNull(T1T2met("L0_s")) = 0 Then tx1 = "L0_s = " + T1T2met("L0_s") + " nm"
            Case 9: If IsNull(T1T2met("L_fm")) = 0 Then tx1 = "L_fm = " + T1T2met("L_fm") + " mm"
            Case 10: If IsNull(T1T2met("S_fm")) = 0 Then tx1 = "S_fm = " + T1T2met("S_fm") + " 10-3 µm²"
            Case 11: If IsNull(T1T2met("T0c")) = 0 Then tx1 = "TO = " + Format(T1T2met("T0c")) + " kPa"
        End Select
        If Len(tx1) > 0 Then
```

```
O.ForeColor = QBColor(IIf(i < 3, 12, 1))
If ressort.Tag = "ph12_STRAIN" Then
    O.CurrentX = 5
Else
    O.CurrentX = IIf(Right(ressort.Tag, 2) = "pT", -3, 15)
End If
O.CurrentY = 108 - i * 3
O.Print tx1
End If
Next 'i
End If
End Sub
```

CP4.2 Calculations and curves of Y, e, e/e₀ as a function of pT

The curve on the computer screen is done by calling the "SUB AAPH_STRAIN_trace()" routine.

Once the data have been recovered (See values displayed in the Tables of Paper 4 and in the Excel sheets of Supplement DA4), the experimental points from published articles and the theoretical curves from model equations are plotted as a function of the relative tension (Fig CP4.2).

A regression is performed between experimental and theoretical parameter values.

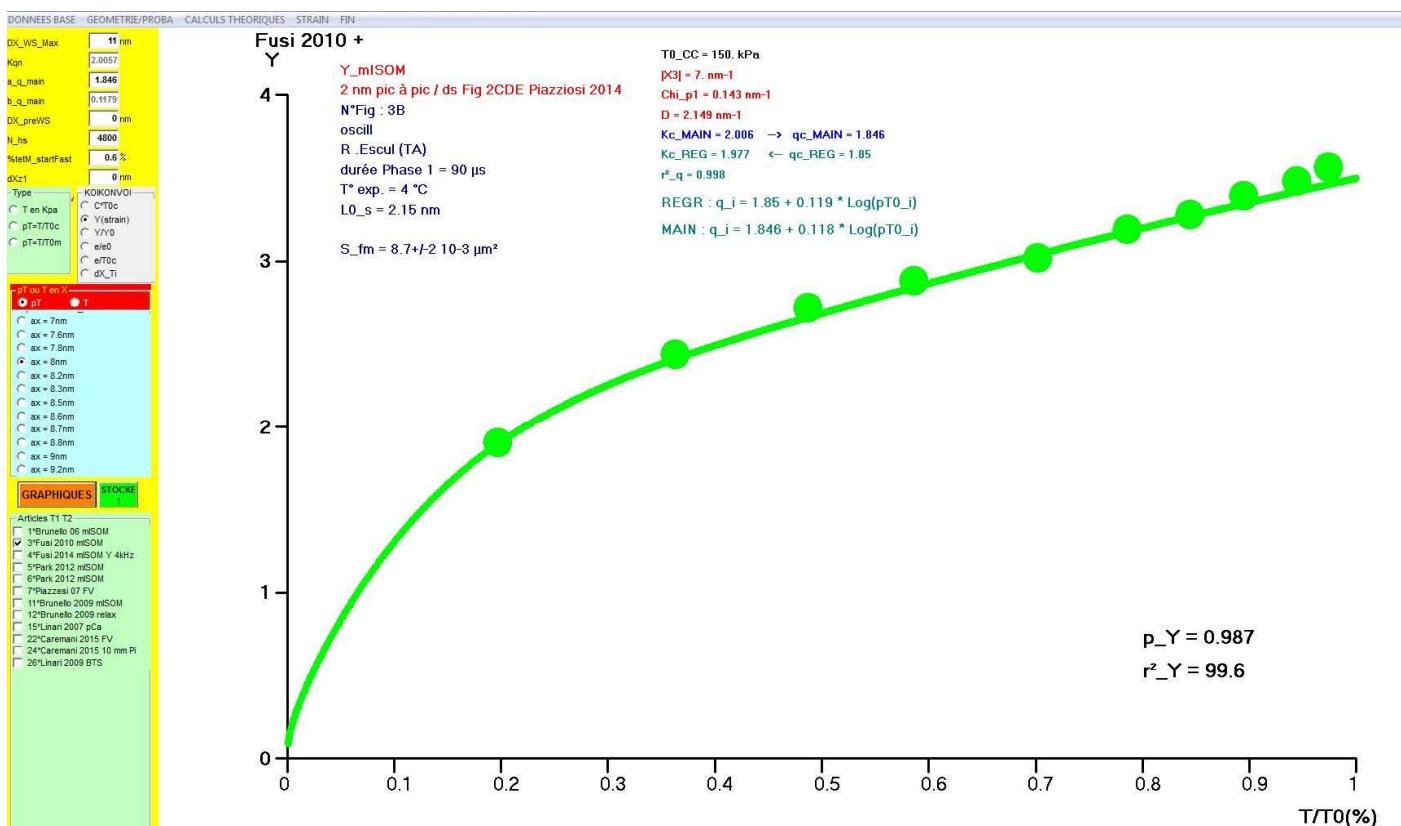


Fig CP4.2 Screenshot after starting the the "Sub AAPH_STRAIN_trace()" routine.

Sub AAPH_STRAIN_trace()

```
Dim e_tt2 As Integer, arti As Integer, N_coché As Integer, a_qOK As Single, b_qOK As Single, Y0_dX_Ti As Single, p_dX_Ti As Single, C2_dX_Ti As Single ', COMPliance As Integer
Dim sXm As Single, sXXm As Single, sYt As Single, sYYt As Single, sXYt As Single, r_deux As Single, chi_i As Single, k_deb As Integer, rayon As Single, no_F As Integer ', pT0_borne As Single
If ressort.Tag <> "ph12_STRAIN" Then Stop
iLeg = 1 ' 0=pas de commentaires 1=commentaires- pour graphiques de l'article
'COMPliance = 0 '1 compliance a la place de Y (strain)
If mmm = 1 Then O.AutoRedraw = True: O.Cls 'verifier que fonction autoredraw=tue
O.Cls
Select Case TE
Case "Divers": k_deb = 500
Case "Edman": k_deb = 1100
Case "Lapin": k_deb = 1200
End Select
Np4 = 1000
e_pt = 30 '50
e_tt = 6
e_tt2 = 2
'hpaged=30 haut=140 large=110
impscale -12, Y0 + 130, X0 + larg, Y0
O.DrawMode = 13
'TAM(1).Enabled = 0 mis à la fin de AA_Neg_affi car Kqn = Kz1 calculé à partit de a_q main donc on le modifie pas
'STRAIN
L_WS = Val(TAM(0).Text) '10
aX = OaX(FraX.Tag).Tag * 2
Xmin = aX - L_WS '3.4 nm
X1 = aX / 2 '3.3 nm'3.33
X2 = -X1
X3 = X1 - L_WS '= (DXmin + DXmax) / 2 '-6.7 '-2*x1
chi_p1 = 1 / Abs(X3) 'pente ss Vis Zone 1 = 2/(DXmin + DXmax)
N_hs = Val(TAM(5).Text) '5000
If N_hs < 10000 Then
'If InStr(T1T2met("methode"), "mISOM") > 0 Then 'les champs b_q et Knz1=K0 sont bloqués
    TAM(1).Enabled = 0
    TAM(3).Enabled = 0
    b_q = 1 / Log(N_hs)
    TAM(3).Text = b_q ' coeff viscosité_tetM_liés indépendante T0
    a_q = Val(TAM(2).Text) 'a_q=q_T0c
    qZ1 = a_q
    KqnZ1 = calcul_Kqn(qZ1)
    TAM(1).Text = KqnZ1
Else 'les champs b_q et Knz1=K0 ne sont plus bloqués
    TAM(1).Enabled = -1
    TAM(3).Enabled = -1
    KqnZ1 = Val(TAM(1).Text) '0.1 '* 2 '0.25 - chi_p1 ' 0.033 * 3 'viscosité_MetZ_disjoints
    a_q = Val(TAM(2).Text) 'a_q=q_T0c
    b_q = Val(TAM(3).Text) ' coeff viscosité_tetM_liés indépendante T0
    N_hs = Val(TAM(5).Text) '5000
    calcul_qOK (KqnZ1) '1 / 8.01 * Log(2800000 / Kqn) '1.9
    qZ1 = qOK
End If
'Oesc(Ix).Tag = Choose(Ix, "Y", "Y/Y0", "e/e0", "e/T0c")
Select Case Fresc.Tag
Case 0: vy = "C": yn = 0: yt = 5: yx = 30 'compliance
Case 1 'Y
    vy = "Y": yn = 0: yt = 1
    Select Case zfm
        Case 503, 504, 511, 512, 1118, 1218: yx = 4
        Case 501, 507: yx = 5
        Case 515, 522, 524: yx = 8
        Case 1108, 1208: yx = 10
    End Select
End Select
```

```

Case Is > 1100: yx = 8
Case Else: yx = 6
End Select

Case 2: vy = "Y/Y0": yn = 0: yx = 1: yt = 0.1
Case 3: vy = "e/e0": yn = 0: yx = 1: yt = 0.1
Case 4: vy = "e/T0": yn = 0: yx = 0.3: yt = 0.05
Case 5: vy = "dX_T0": yn = 0: yx = IIf(zfm = 1109 Or zfm = 1110 Or zfm = 1111, 18, 15): yt = 1
Case Else: Stop
End Select

'T0c = 1 '300 kPa?'on travaille sur pT pour l'instant
T0c = 1: vx = "T/T0(%)": xn = 0: xx = 1: xt = 0.1

imprenvi
N_fm = 0 'compteur de tracées
tx2 = IIf(FrpTouT.Tag = 0, "pT", "T")

'pour savoir si 1 plusiers coché
For arti = 0 To N_articles - 1
    If ChT1T2(arti) = 1 Then N_coché = N_coché + 1
Next

zYb = "_dX_Ti"
For arti = 0 To N_articles - 1
    If ChT1T2(arti) = 1 Then 'c'est ok
        'rappel 1 : on prend exclusivement d'après choix de oesc(fr.esc.tag).tag
        'rappel 2 : Nfm (500_1100 (Edman) _1200(L apin) +?) concernée stockée ChT1T2(t).Tag = sTRain("cas")

'en 1 pour temp etudie ensemble a partir du T0 de 0°C
z = ChT1T2(arti).Tag
'zfm = z + 500
zfm = k_deb + z
N_fm = N_fm + 1

'les compléments
T1T2met.Seek "=", zfm: If T1T2met.NoMatch Then Stop
sTRain.Seek "=", z, -99: If sTRain.NoMatch Then Stop
If FrpTouT.Tag = 1 Then T0_CC = sTRain("T0")

'Pvaluers consigne pour modélisation de dX_Ti
no_F = 0 'par défaut
If IsNull(sTRain("no_F")) = 0 Then
    no_F = sTRain("no_F")
    If IsNull(sTRain("Yhyp")) = 0 Then
        Yhyp = sTRain("Yhyp")
    Else
        Yhyp = 0
    End If
    bo1_pT = sTRain("bo1_pT")
    If IsNull(sTRain("bo2_pT")) = 0 Then
        bo2_pT = sTRain("bo2_pT")
    Else
        bo2_pT = 0
    End If
End If

'tracés des pts surtout tout laisser ici
'O.DrawWidth = e_tt
If Fresc.Tag = 5 Then 'dX_Ti

'If zfm = 505 Or zfm = 506 Or zfm = 507 Or zfm = 511 Or zfm = 512 Or zfm = 516 Or zfm = 517 Then

```

```

' O.DrawWidth = e_pt 'courbe
'ElseIf zfm = 1101 Or zfm = 1102 Then 'Parkn / Piazzesi FV2007
' O.DrawWidth = e_pt 'courbe
'Else
' O.DrawWidth = e_pt * 1.5 'insert/encart
'End If
Else
    O.DrawWidth = e_pt
End If
*****
'If N_coché = 1 Then 'REGresion si un seul article coché
sN = 0: sX = 0: sXX = 0: sY = 0: sYY = 0: sXY = 0
sXm = 0: sXXm = 0: sYt = 0: sYYt = 0: sXYt = 0
sTRain.MoveNext
Do While sTRain("cas") = z
    'X_pT ou X_T
    If IsNull(sTRain("X_" + tx2)) = 0 And IsNull(sTRain("Y")) = 0 Then
        '1 recuper Ymesurées
        xav = sTRain("X_" + tx2) 'pT0i=T0i/T0c
        If Fresc.Tag = 5 Then
            yav = sTRain("dX_Ti")
        Else
            yav = sTRain("Y") 'Yi ou Yi/Y0 ou ei/e0 ou e1/T0
            If yav < 0 Then Stop
        End If
    If Fresc.Tag < 5 Then 'pas dX_Ti
        If FrCHI.Tag = 2 And no_F > 0 Then 'chi variable
            AAPH_STRAIN_CONSIGNE_calcul no_F
            If dX_Ti < 0 Then Stop
            chi_i = 1 / (L_WS - dX_Ti / 2)
        Else 'chi fixe
            chi_i = chi_p1
        End If
        Select Case Fresc.Tag
            Case 0: Kqn = 1 / (chi_i * yav * xav) 'Yi = 1/(chi_i* Ki*pT0i) --> Ki= 1/(chi_i* Yi*pT0i)
            Case 1: Kqn = 1 / (chi_i * yav) 'Yi = 1/(chi_i* Ki) --> Ki= 1/(chi_i* Yi)
            Case 2: Kqn = (chi_p1 * KqnZ1) / (chi_i * yav) 'Yi/Y0 = (chi_p1 * K0) / (chi_i* Ki) --> Ki= [[chi_p1 * Kz1]/chi_i]*(1/(Y0/Yi))
            Case 3: Kqn = yav * chi_p1 * KqnZ1 / (chi_i * xav) 'ei/e0 = [(chi_p1_i* Ki)/(chi_p1*Kz1)]*pT0i --> Ki= (e1/e0) * (Kz1*
chi_p1*Kz1)/(chi_i*pT0i)
            Case 4: Kqn = yav / (xav * chi_i) 'ei/T0c = pT0i * Ki * chi_i--> Ki= (e1/T0c)/(Chi_i*pT0i)
        End Select
        If zfm = 1216 And sTRain("pt") = 1 Then
            'Kqn=750
            Stop 'juste pour revoir
            qOK = 0.3
        Else
            If (Kqn < 1 Or Kqn > 16) Then Stop
            calcul_qOK (Kqn)
        End If
    '2/ on stocke
    sTRain.Edit
    sTRain("Ki_mes") = Kqn 'Ki calculé à partir de Yi ,yi/Y0, ei/e0 ou ei/T0
    sTRain("qi_mes") = qOK 'qi calculé à partir de Ki_mes par interpolatinc
    sTRain.Update
    '3/ on régresse
    If T1T2met("facteur") = "temperature" Then 'Davis temperature
        xmi = sTRain("X_pT")
    Else
        xmi = Log(sTRain("X_pT"))

```

```

End If

sN = sN + 1           'qi= qc + p x Log(pT0i)  Temp: qi= qc + p x (pT0i-1)
sX = sX + xmi: sXX = sXX + xmi ^ 2 'X=Log(pT0i)      Temp: X=(pT0i-1)
sY = sY + qOK: sYY = sYY + qOK ^ 2 'Y=qi
sXY = sXY + xmi * qOK
End If 'if fresc.tag=5

'4/ on trace
If Fresc.Tag < 5 Then
  If zfm = 501 Or zfm = 502 Or zfm = 1109 Or zfm = 1110 Or zfm = 1111 Then 'Brunello_2006
    O.DrawWidth = e_pt * 1.5
  ElseIf zfm = 503 Or zfm = 1115 Then
    O.DrawWidth = e_pt * 1.2
  ElseIf zfm = 507 Or zfm = 511 Or zfm = 512 Or zfm = 1117 Or zfm = 1118 Or zfm = 1112 Or zfm = 1120 Then
    O.DrawWidth = e_pt * 1.1
  Else
    O.DrawWidth = e_pt * IIf(zfm = 1115, 1.2, 1)
  End If

Else 'Fresc.Tag = 5 dX_Ti
  If zfm = 503 Or zfm = 505 Or zfm = 506 Or zfm = 516 Or zfm = 517 Then
    O.DrawWidth = e_pt
  ElseIf zfm = 511 Or zfm = 512 Then
    O.DrawWidth = e_pt * 1.1
  ElseIf zfm = 507 Or zfm = 1115 Or zfm = 1117 Or zfm = 1118 Then
    O.DrawWidth = e_pt * 1.2
  ElseIf zfm = 1205 Or zfm = 1206 Then
    O.DrawWidth = e_pt
  Else
    O.DrawWidth = e_pt * 1.5 'pour les inserts
  End If
End If
xap = (xav - xn) * 100 / (xx - xn)
yap = (yav - yn) * 100 / (yx - yn)
'croix
If (zfm = 1102 And sTRain("pt") > 4) Or (zfm = 1119 And sTRain("pt") > 6) Then
  O.DrawWidth = IIf(Fresc.Tag < 5, 5, 8)
  xmi = 2 'IIf(Fresc.Tag < 5, 2, 3)
  ymi = 3 'IIf(Fresc.Tag < 5, 2.67, 4)
  O.Line (xap - xmi, yap)-(xap + xmi, yap), QBColor(sTRain("coul_pt"))
  O.Line (xap, yap - ymi)-(xap, yap + ymi), QBColor(sTRain("coul_pt"))

Else 'point
  O.PSet (xap, yap), QBColor(sTRain("coul_pt"))
End If

If Fresc.Tag < 5 Then 'pas dX_Ti

  If k_deb >= 1100 Then
    If IsNull(sTRain("Ect_" + tx2)) = 0 And IsNull(sTRain("Ect_Y")) = 0 Then 'tx2 = IIf(FrpTouT.Tag = 0, "pT", "T")
      If sTRain("Ect_" + tx2) > 0 And sTRain("Ect_Y") > 0 Then
        O.DrawWidth = 1
        xmi = (sTRain("Ect_" + tx2) - xn) * 100 / (xx - xn)
        ymi = (sTRain("Ect_Y") - yn) * 100 / (yx - yn)
        rayon = IIf(xmi >= ymi, xmi, ymi) / 2
        O.Circle (xap, yap), rayon, QBColor(sTRain("coul_pt")), , , ymi / xmi
        'O.DrawWidth = e_pt
      End If
    End If
  End If
End If

```

```

'5/calcul Y theoriques
If T1T2met("facteur") = "temperature" Then 'Davis temperature
  ' qOK = T1T2met("a_q_main") + xav / Log(N_hs)
  'ou qOK = T1T2met("a_q_main") + (xav-1) / Log(N_hs)
  'ou qOK = T1T2met("a_q_main")- 1/Log(N_hs) + xav / Log(N_hs)
  Stop 'a retester avec excel
Else
  qOK = T1T2met("a_q_main") + Log(xav) / Log(N_hs) 'qi_theoretical
End If

Kqn = calcul_Kqn(qOK) 'Ki_theoretical

If FrCHI.Tag = 2 And no_F > 0 Then 'Chi_i variable et modélisée selon 4 types
  AAPH_STRAIN_CONSIGNE_calcul no_F
  chi_i = 1 / (L_WS - dX_Ti / 2)
Else 'Chi_i fixe
  chi_i = chi_p1
End If

Select Case Fresc.Tag 'Yi_theoretical
Case 0: ymi = 1 / (chi_i * Kqn * xav) ' Yi = T0/(Chi_p1 * Yi*T0i)=1/(Chi_p1 * Yi*pT0i)
Case 1: ymi = 1 / (chi_i * Kqn) ' Yi = 1/(Chi_p1 * Yi)
Case 2: ymi = (chi_p1 * KqnZ1) / (chi_i * Kqn) ' Yi/Y0 = (Kz1*chi_p1)/(Ki/chi_p1_i)
Case 3: ymi = xav * (chi_i * Kqn) / (chi_p1 * KqnZ1) 'ei/e0 =pT0i* Ki/chi_p1_i) / (Kz1*chi_p1)
Case 4: ymi = Kqn * chi_i * xav ' ei/T0 = Ki* chi_p1*pT0i
End Select

'6/ on re-stocke
sTRain.Edit
sTRain("qi_th") = qOK 'qi_theoretical eq_27_Papier4
sTRain("Ki_th") = Kqn 'Ki_theoretical eq_26_Papier4
sTRain("Yt") = ymi 'Yi_theoretical eq_28a_28b_Papier4
Select Case Fresc.Tag '0=C 1=Y 2=Y/Y0 3=e/e0 4=e/T0
Case 0: xmi = yav * Kqn * xav ' Ci = 1/(chi_i* Ki*pT0i) --> 1/(chi_i= Yi * Ki*pT0i)
Case 1: xmi = yav * Kqn ' Yi = 1/(chi_i* Ki) --> 1/chi_i= Yi * Ki
Case 2: xmi = yav * Kqn / (KqnZ1 * chi_p1) ' Yi/Y0 = (chi_z1 * Kz1)/(chi_i* Ki)--> 1/chi_i= (Yi/Y0)*Ki/(Kz1*chi_p1)
Case 3: xmi = (1 / yav) * Kqn * xav / (KqnZ1 * chi_p1) ' ei/e0 = pT0i * (chi_i* Ki)/(Chi_p1*Kz1) --> 1/Chi_i =
[1/(ei/e0)]*(Ki*pT0i)/(chi_p1*Kz1)
Case 4: xmi = Kqn * xav / yav ' ei/T0 = T0i/T0 * chi_i* Ki --> 1/Chi_i) = Ki*pT0i/(chi_p1*Kz1)
End Select

'Y sTRain("dX_Ti") = 2 * (L_WS - sTRain("Y") / (chi_p1 * ymi))
sTRain("dX_Ti") = 2 * (L_WS - xmi) 'dX_Ti_mes eq_30a_30b_Papier4 avec xav=PT0i mesure et yav=Yi mesure
'If sTRain("dX_Ti") > L_WS Then Stop 'verif
sTRain.Update

'7/ on re-régresse
'sN fait avant
sXm = sXm + yav: sXXm = sXXm + yav ^ 2 'Xm = Ymesuré
sYt = sYt + ymi: sYYt = sYYt + ymi ^ 2 'Yy= Ytheoriq=qj
sXYt = sXYt + yav * ymi
End If
End If
sTRain.MoveNext: If sTRain.EOF Then Exit Do
Loop

If Fresc.Tag < 5 Then 'on enregistre la regression ds T1T2met : q en fonction pT0i
  If sN < 2 Then Stop '?'
  'r
  r_regL = (sXY - sX * sY / sN) / Sqr((sXX - sX * sX / sN) * (sYY - sY * sY / sN))
  'pente
  p_regL = (sXY - sX * sY / sN) / (sXX - sX * sX / sN)
  'ordonné à l'origine
  Y0_
  T1T2met.Edit
    T1T2met("r2_q_REG") = r_regL ^ 2
    T1T2met("a_q_REG") = Y0_regL
    T1T2met("b_q_REG") = p_regL
  T1T2met.Update

```

```

***** regression entre Ymesurées et Y theoriques du modele
O.ForeColor = coul
'pente
'droite passant par l'origine maois piege car pb d'homothétie
p_regL = sXYt / sXXm
r_deux = 1 - (sYYt - 2 * p_regL * sXYt + sXXm * (p_regL ^ 2)) / (sYYt - sYt * sYt / sN)
'donc on revient à la normale
p_regL = (sXYt - sXm * sYt / sN) / (sXXm - sXm * sXm / sN)
r_regL = (sXYt - sXm * sYt / sN) / Sqr((sXXm - sXm * sXm / sN) * (sYYt - sYt * sYt / sN))
If r_deux > 1 Then Stop 'bizarre
txV = Choose(Fresc.Tag + 1, "C*T0c", "Y", "Y/Y0", "e/e0", "e/T0c")
O.ForeColor = QBColor(0)
O.CurrentX = 80: O.CurrentY = 20: O.Print "p_" + txV + " = " + Format(p_regL, "0.###")
O.CurrentX = 80: O.CurrentY = 15: O.Print "r2_" + txV + " = " + Format(r_deux * 100, "##.##")
End If 'fresc.tag<5
***** regression entre Ymesurées et Y theoriques du modele
'trace courbe adhoc
O.DrawStyle = 0
O.DrawWidth = e_tt
'pt départ
xav = 1 / Np4 '* IIf(FrpTouT.Tag = 0, 1, T0_CC)
If FrCHI.Tag = 2 And no_F > 0 Then 'Chi variable
AAPH_STRAIN_CONSIGNE_calcul no_F
    chi_i = 1 / (L_WS - dX_Ti / 2)
Else
    chi_i = chi_p1
End If
qOK = T1T2met("a_q_main") + T1T2met("b_q_main") * Log(1 / Np4) 'qoK theorie
Kqn = calcul_Kqn(qOK) 'Ki théorique
Select Case Fresc.Tag
Case 0: yav = 1 / (chi_i * Kqn * xav)
Case 1: yav = 1 / (chi_i * Kqn) ' Yi = 1/(Chi_p1 * Yi)
Case 2: yav = (chi_p1 * KqnZ1) / (chi_i * Kqn) ' Yi/Y0 = (Kz1*chi_p1)/(Ki/chi_p1_i)
Case 3: yav = xav * (chi_i * Kqn) / (chi_p1 * KqnZ1) 'ei/e0 =pT0i* Ki/chi_p1_i) / (Kz1*chi_p1)
Case 4: yav = Kqn * chi_i * xav ' ei/T0 = Ki* chi_p1*pT0i
Case 5: xav = 0: yav = 0
End Select
O.CurrentX = (xav - xn) * 100 / (xx - xn)
O.CurrentY = (yav - yn) * 100 / (yx - yn)
Select Case zfm
Case 505, 506 'Park dogfish
    drap = IIf(zfm = 505, 7, 12) 'stepL=gris osc=rouge
    If Fresc.Tag = 5 Then drap = 11: O.DrawWidth = 12
'Case 507 'piazzesi FV dX_Ti
' If Fresc.Tag = 5 Then drap = 0: O.DrawWidth = 4
Case 516, 1212 'EDman 97 FV
    drap = 4: If Fresc.Tag = 5 Then O.DrawWidth = 4
Case 517, 1113, 1213 'EDman 97 mISOM
    drap = 12: If Fresc.Tag = 5 Then O.DrawWidth = 4
Case Else
    If FrCHI.Tag = 2 And no_F > 0 Then
        If zfm = 503 Or zfm = 508 Or zfm = 509 Or zfm = 510 Or zfm = 1117 Or zfm = 1118 Then
            O.DrawWidth = 9 'IIf(zfm = 1115, 9, 12) 'cecchi 86 specail
        ElseIf zfm = 511 Or zfm = 512 Then
            O.DrawWidth = 7
        ElseIf Fresc.Tag < 5 And (zfm = 507 Or zfm = 1112 Or zfm = 1120) Then
            O.DrawWidth = 7
        Else
            O.DrawWidth = 12
        End If
        drap = Choose(Fresc.Tag + 1, 1, 10, 2, 12, 13, 11, 0) 'C=11 bleu ciel Y=vert clair Y/Y0=vert foncé e/e0=rouge e/T0 mauve
    Else

```

```

O.DrawWidth = 4
drap = Choose(Fresc.Tag + 1, 1, 2, 2, 5, 5, 8, 0) 'C=11 bleu ciel Y=vert clair Y/Y0=vert foncé e/e0=rouge e/T0 mauve
End If
End Select
If zfm = 511 Then drap = 10
If zfm = 512 Then drap = 3 'petit rectificatif
coul = QBColor(drap) 'bleu
If FrpTouT.Tag = 1 Then Stop 'je fais pas
For i = IIf(Fresc.Tag = 5, 1, 2) To Np4 ' tx2 = IIf(FrpTouT.Tag = 0, "pT", "T")
'T0i ou pT0i
xav = i / Np4 ' * IIf(FrpTouT.Tag = 0, 1, T0_CC)
'chi_p1_i
If FrCHI.Tag = 2 And no_F > 0 Then 'Chi variable
AAPH_STRAIN_CONSIGNE_calcul no_F
chi_i = 1 / (L_WS - dX_Ti / 2)
Else
    chi_i = chi_p1
End If
'Ki
a_qOK = T1T2met("a_q_main")
b_qOK = T1T2met("b_q_main")
If T1T2met("facteur") = "temperature" Then
    qOK = a_qOK + b_qOK * i / Np4
Else
    qOK = a_qOK + b_qOK * Log(i / Np4)
End If
'qOK = T1T2met("a_q_REG") + T1T2met("b_q_REG") * Log(i / Np4) 'toujours log (pT)
Kqn = calcul_Kqn(qOK)
Select Case Fresc.Tag
Case 0: yav = 1 / (chi_i * Kqn * xav) ' Compliance Yi = 1/(Chi_p1 * Yi)
Case 1: yav = 1 / (chi_i * Kqn) ' Yi = 1/(Chi_p1 * Yi)
Case 2: yav = (chi_p1 * KqnZ1) / (chi_i * Kqn) ' Yi/Y0 = (Kz1*chi_p1)/(Ki/chi_p1_i)
Case 3: yav = xav * (chi_i * Kqn) / (chi_p1 * KqnZ1) 'ei/e0 =pT0i* Ki/chi_p1_i) / (Kz1*chi_p1)
Case 4: yav = Kqn * chi_i * xav ' ei/T0 = Ki* chi_p1*pT0i
Case 5
    If FrCHI.Tag = 2 And no_F > 0 Then 'Chi variable
        yav = dX_Ti
    Else
        yav = aX
    End If
End Select
xap = (xav - xn) * 100 / (xx - xn)
yap = (yav - yn) * 100 / (yx - yn)
O.Line -(xap, yap), coul
Next 'i
End If 'If ChT1T2(arti) = 1 Then 'c'est ok
Next 'arti

'__il faut d'abord trace les courbes selon choix puis les points (à cause differentes unites en Y
If Fresc.Tag = 5 Then
    ' trait dX_Max dans insert /encart
    O.DrawWidth = 1: O.DrawStyle = 2
    ymi = (L_WS - yn) * 100 / (yx - yn)
    O.Line (0, ymi)-(100, ymi), QBColor(0)
    ' O.DrawWidth = e_tt * 2
    ' trait dX_T
    ymi = (aX - yn) * 100 / (yx - yn)
    O.Line (0, ymi)-(10, ymi), QBColor(0) 'coul

```

```

'equation
If FrCHI.Tag = 2 And no_F > 0 Then AAPH_STRAIN_CONSIGNE_affi no_F
Elseif iLeg = 1 Then
  O.FontSize = 11
  O.FontBold = -1
  'legende 'legende en haut à gauche
  For i = 1 To 9
    Select Case i
      Case 1: xav = T0_CC: tx1 = "T0_CC"
      Case 2: xav = Abs(X3): tx1 = "|X3|"

      Case 3: xav = chi_p1: tx1 = "Chi_p1"
      Case 4: xav = chi_p1 + KqnZ1: tx1 = "D"

      Case 5: xav = KqnZ1: tx1 = "Kc_MAIN"
      Case 6: xav = qZ1: tx1 = "--> qc_MAIN"

      Case 7: xav = T1T2met("a_q_REG"): tx1 = "<-- qc_REG"
      Case 8: qOK = T1T2met("a_q_REG"): xav = calcul_Kqn(qOK): tx1 = "Kc_REG"

      Case 9: xav = T1T2met("r2_q_REG"): tx1 = "r2_q"
    End Select

    O.CurrentX = IIf(i = 6 Or i = 7, 60, 50) - 15
    O.CurrentY = Choose(i, 107, 104, 101, 98, 95, 95, 92, 92, 89, 86, 83, 80)

    O.ForeColor = QBColor(Choose(i, 0, 12, 12, 12, 9, 9, 3, 3, 3, 5, 8, 7))
    tx1 = tx1 + " = " + Format(xav, "0.###")
    Select Case i
      Case 1: tx1 = tx1 + " kPa"
      Case Is < 5: tx1 = tx1 + " nm-1"
    End Select
    O.Print tx1
  Next i

  tx1 = IIf(T1T2met("facteur") = "temperature", " * pT0_i", " * Log(pT0_i)")
  O.FontSize = 12
  O.CurrentX = 45 - 10: O.CurrentY = 85
  O.Print "REGR : q_i = " + Format(T1T2met("a_q_REG"), "#.###") + " + " + Format(T1T2met("b_q_REG"), "0.###") + tx1
  O.CurrentX = 45 - 10: O.CurrentY = 81
  O.Print "MAIN : q_i = " + Format(T1T2met("a_q_MAIN"), "#.###") + " + " + Format(T1T2met("b_q_MAIN"), "0.###") + tx1
AAPH_ART_legende

End If

End Sub

```

Sub AAPH_STRAIN_CONSIGNE_calcul(lz As Integer)

'lz = No_F de la fonction modelisant consigne vers dX_Ton calcul Y

'xav = pT0i

Select Case lz

Case 1 'montée exponentielle : pCA,Pi

$dX_{Ti} = aX * (1 - \text{Exp}(-bo1_pT * xav) * (1 + bo2_pT * xav))$

Case 2 ' descente exponentielle de dX_Max à dX_T : montée en isométrie

$dX_{Ti} = aX + (L_WS - aX) * \text{Exp}(-bo1_pT * xav) * (1 + bo2_pT * xav)$

Case 3 ' descente exponentielle de dX_Max à dX_T avec initaition psaou periodique : montée en isometrie

$dX_{Ti} = aX + (L_WS - aX) * \text{Exp}(-bo1_pT * xav) * \text{Cos}(bo2_pT * xav)$

Case 4 'sigmoide descendante de dX_T à 0 (relaxation apres tetanisation)

$dX_{Ti} = aX / (1 + \text{Exp}(-bo1_pT * (xav - bo2_pT)))$

Case 5 'SIGMOIDE montante : courbe FV

$dX_{Ti} = L_WS + (aX - L_WS) / (1 + \text{Exp}(-bo1_pT * (xav - bo2_pT)))$

Case Else: Stop

End Select

If dX_Ti > 17 Then Stop

End Sub

Sub AAPH_STRAIN_CONSIGNE_affi(z1 As Integer)

```
Dim e_ht As Integer
e_ht = 4
O.FontSize = 12
xap = 30: yap = 12
k = Choose(z1, 1, 2, 2, 3, 4)
If k = 2 Or k = 4 Then O.CurrentX = xap + 15: O.CurrentY = yap + 2 * e_ht: O.Print "dX_Max - dX_T = " + Format(L_WS - aX) + "
nm"

O.CurrentX = xap: O.CurrentY = yap: O.Print "Langda_" + Format(k) + " = " + Format(bo1_pT)
If bo2_pT <> 0 Then O.CurrentX = xap: O.CurrentY = yap - e_ht: O.Print "Omega_" + Format(k) + " = " + Format(bo2_pT)

Select Case z1
Case 1 'exp montante :: pCA,Pi
    If bo2_pT = 0 Then
        tx1 = "dX_Ti = dX_T * (1- Exp(-Langda_1 * pT0i ))"
    Else
        tx1 = "dX_Ti = dX_T + [1- Exp(-Langda_1 * pT0i) * (1 + Omega_1 * pT0i)]"
    End If
    tx2 = "EXPO montante : CAS Général"

Case 2 'descente exponentielle de dX_Max à dX_T : montée en isométrie
tx1 = "dX_Ti = dX_T + (dX_Max - dX_T) * Exp(-Langda_2 * pT0i) * (1 + Omega_2 * pT0i)"
tx2 = "EXPO descendante : CAS Général"

Case 3 'descente exponentielle de dX_Max à dX_T avec initaiton psau periodique : montée en isometrie
tx1 = "dX_Ti = dX_T + (dX_Max - dX_T) * Exp(-Langda_2 * pT0i) * Cos(Omega_2 * pT0i )"
tx2 = "EXPO descendante + COS (oscillations)"

Case 4 ' descendante de dX_T à 0 (relaxation apres tetanisation )
tx1 = "dX_Ti = dX_T / [ 1 + exp(-Langda_3 * (pT0i - Omega_3)) ]"
tx2 = "SIGMOIDE descendante"

Case 5 'SIGMOIDE montante de dX_T à dX_Max : courbe FV
tx1 = "dX_Ti = dX_Max+(dX_T-dx_Max) / [1+exp(-Langda_4 * (pT0i -Omega_4))] "
tx2 = "sigmoide montante"

Case Else: Stop
End Select

O.CurrentX = xap: O.CurrentY = yap - 2 * e_ht
O.Print "Eq : " + tx1
O.CurrentX = xap - 7: O.CurrentY = yap + e_ht: O.Print "No fonction : " + Format(z1) + " (" + tx2 + ")"

End Sub
```