```
110     FORMAT(5X,'LIQUID FLOWRATE, lb/hr.:', T60, F10.0,/,
     1         5X,'VAPOR FLOWRATE, lb/hr.:', T60, F10.0,/,
     2         5X,'LIQUID DENSITY, lb/ft^3.:', T60, F9.3,/,
     3         5X,'VAPOR DENSITY, lb/ft^3.:',  T60, F9.3,/,
     4         5X,'SURGE TIME, min.:', T60, F6.1)

       WRITE(1, 120)SF1, KV1, VMAX1, D1
120    FORMAT(5X,'SEPARATION FACTOR:', T60, F8.4,/,
     1         5X,'VAPOR VELOCITY FACTOR:', T60, F8.3,/,
     2         5X,'MAXIMUM VAPOR VELOCITY, ft/s.:',T60, F8.3,/,
     3         5X,'VESSEL DIAMETER, ft:', T60,F8.3)

       WRITE(1, 130)UMIN, UMAX, V, HL
130    FORMAT(5X,'MINIMUM VAPOR-LIQUID NOZZLE VELOCITY, ft/s.:', T60,
     1  F8.3,/,5X,'MAXIMUM VAPOR-LIQUID NOZZLE VELOCITY, ft/s.:',T60,
     2  F8.3,/,5X,'REQUIRED VESSEL VOLUME, ft^3:',T60,F8.3,/,
     3          5X,'LIQUID HEIGHT, ft.:',T60, F8.3,///)

       RETURN
       END

C
C      ***************************************************************
C      THIS PROGRAM PRINTS THE RESULTS OF THE HORIZONTAL SEPARATOR
C
C      ***************************************************************
C
       SUBROUTINE OUTH
       REAL L, KH

       COMMON/AKIN3/WL2, WV2, DENL2, DENV2, RATIO
       COMMON/AKIN4/SF2, KH, QV2, VMAX2, D2, L, VESVOL,T2

       WRITE(1, 200)
200    FORMAT(//,25X,'HORIZONTAL SEPARATOR SIZING',/74(1H*))

       WRITE(1, 210)WL2, WV2, DENL2, DENV2, RATIO
210    FORMAT(5X,'LIQUID FLOWRATE, lb/hr.:', T60, F10.0,/,
     1         5X,'VAPOR FLOWRATE, lb/hr.:', T60, F10.0,/,
     2         5X,'LIQUID DENSITY, lb/ft^3.:', T60, F9.3,/,
     3         5X,'VAPOR DENSITY, lb/ft^3.:', T60, F9.3,/,
     4         5X,'LENGTH TO DIAMETER RATIO (L/D):', T60, F6.1)


       WRITE(1, 220) SF2, KH, QV2, VMAX2
220    FORMAT(5X,'SEPARATION FACTOR:',T60,F8.3,/,
     1         5X,'VAPOR VELOCITY FACTOR:',T60,F8.3,/,
     2         5X,'VAPOR VOLUMETRIC RATE, ft^3/s.:', T60, F9.3,/,
     3         5X,'MAXIMUM VAPOR VELOCITY, ft/s.:',T60, F8.3)

       WRITE(1, 230) D2, L, VESVOL, T2
230    FORMAT(5X,'VESSEL DIAMETER, ft.:',T60, F8.3,/,
     1         5X,'VESSEL LENGTH, ft.:', T60, F8.3,/,
     2         5X,'VESSEL VOLUME, ft^3.:', T60, F9.3,/,
     3         5X,'SURGE TIME, min.:', T60, F8.3)


       RETURN
       END
```

OGJ

though it is unsuitable for fouling service.

The wire mesh demister is a widely applied separator type and is adequate for all gas-liquid flow regimes over a wide range of gas flow rates.

A knockout drum or demister separator may be either a vertical or horizontal vessel.

A vertical vessel is generally preferred because its efficiency does not vary with liquid level. Alternatively, a horizontal vessel is chosen when it offers a clear size advantage when headroom is restricted or when a three-phase separation is required.

Knockout drums and cyclones are recommended for waxy and coking feeds. Demister mats are not suitable with these feeds because of the danger of plugging. Vane demister packages are used as alternatives, but cleaning provisions should be made.

## Separator sizing

Vertical liquid-vapor separators are used to disengage a liquid from a vapor when the volume of liquid is small compared with the vapor volume.

The maximum allowable vapor velocity in a vertical separator that reduces the liquid carry-over depends upon:

- Liquid and vapor densities
- A constant, K, based on surface tension, droplet size, and physical characteristics of the system (see Nomenclature).

The proportionality constant, K, is 0.35 for oil and gas systems with at least 10 in. disengaging height between the mist-eliminator bottom and gas-liquid interface. For vertical vessels, K can vary between 0.1 and 0.35 if mist eliminators (demisters) are used to enhance disentrainment.

The value of K also depends on the operating pressure of the vessel. At pressures above 30 psig, K decreases with pressure, having an approximate value of 0.30 at 250 psig and 0.275 at 800 psig.

Watkins developed a correlation between the separation factor and K.[1] Fig. 3 illustrates Watkins' vapor velocity factor chart, based on 5% of the liquid being entrained with the vapor. Blackwell developed a polynomial equation using Watkins' data to calculate the K value for a range of separation factors between 0.006 and 5.0.[2]

Watkins proposed a method for sizing reflux drums based on several factors, as illustrated in Tables 1 and 2.

Table 1 gives the recommended design surge times; Table 2, the multiplying factors for various operator efficiencies.

The operating factor is based on the external unit and its operation, its instru-

Fig. 2