Design of Complex Wire-Mesh Mist Eliminators

Elisabetta Brunazzi and Alessandro Paglianti
Dept. of Chemical Engineering, Industrial Chemistry and Materials Science, University of Pisa, I-56126 Pisa, Italy

Knitted wire-mesh mist eliminators have widespread application in many industrial plants. Despite their extensive use, the open literature regarding them is really limited. Some experimental data and mechanistic models have been published for common knitted wire-mesh mist eliminators formed from a single metal pad. This type of mist eliminator can be used in most distillation and absorption columns, but because of the poor removal efficiency, cannot be used in operations involving acid mist, fine fog resulting from liquid condensation from a saturated vapor, oil mist from compressed gases, and natural-gas dehydration applications. Moreover, other possible problems may arise when the separator is fed with high liquid and gas flow rates, because these conditions can induce flooding in the mist eliminator. In both of these cases, common wire-mesh mist eliminators do not perform satisfactorily, and therefore complex wire-mesh mist eliminators have to be installed to improve separation efficiency or to increase allowable liquid loadings while avoiding flooding phenomena. This article presents a mechanistic model based on a set of new experimental data obtained by investigating performance of commercial complex eliminators.

Introduction

In chemical plants, removal of entrained liquid from gas or vapor streams may be required not only to recover valuable products or to protect downstream equipment from corrosive liquids, but may also be necessary to improve emission controls. Selection of the proper collecting equipment depends mainly on the size distribution of the entrained liquid droplets.

The present work regards separation of entrained liquid from the gaseous current and considers droplet size from around 1 micron upwards, particular attention being focused on the overlapping size region between the coarsest mist particles and the finest spray particles. The aim of this article is to study two of the main problems arising in gas–liquid separation when common wire-mesh eliminators are used: how to obtain a high separation efficiency even with a large quantity of liquid entering the collector; and how to obtain a high separation efficiency when a large number of small droplets with diameter of a few microns are present.

Wire-mesh contactors are made by knitting wires to form a layer that can be rolled spirally to form cylindrical elements (which are commonly used for small-diameter applications) or folded into several layers to form a pad of the desired thickness. In the present article, two evolutions of the original wire-mesh contactors have been analyzed experimentally: "the multilayer separators," formed from two or three metal pads in series, and "the composite separators," which consist of knitted mesh eliminators that incorporate a multifilament yarn into the basic wire-mesh structure (see Figure 1). The metal wire used in the knitted multilayer generally has a diameter in the 80–280-μm range and the typical thickness used for each pad is between 20 and 100 mm. The composite separators are usually made from the same type of basic metal wire that is used for the common metal wire mesh. Fiber diameters range from 9 to 30 microns, depending on the fiber material. Common materials of the multifilament yarns are polypropylene, Dacron, Teflon, and glass fiber. The selection of the fiber material depends on the requirements imposed by the process conditions (such as corrosion resistance, temperature, liquid loads). For instance, polypropylene and Dacron yarns, which are cheaper than Teflon yarns, are appropriate for process temperatures up to 50°C and 70°C, respectively, whereas Teflon yarns can be used up to 180°C. Composite separators made from glass-fiber yarns exhibit an extraordinarily high specific surface, therefore allowing high removal efficiency, but can only treat gas streams with low liquid loads.

Some articles have been published on the use of common wire-mesh mist eliminators. All of these articles essentially

Correspondence concerning this article should be addressed to A. Paglianti.

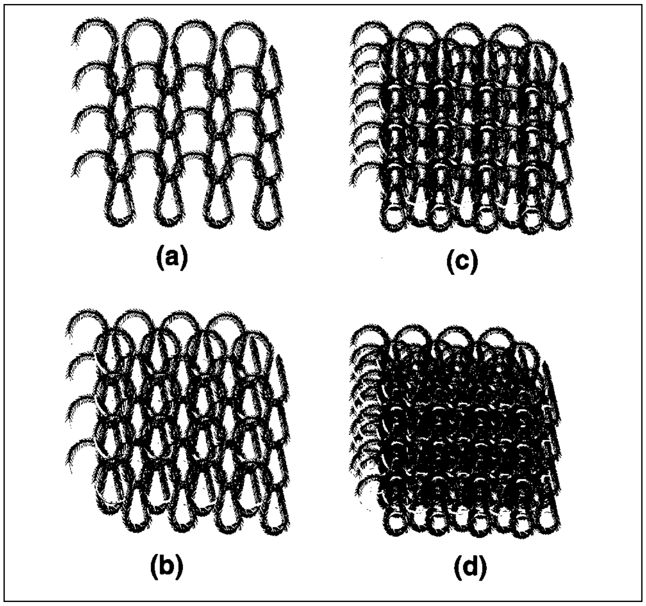

Figure 1. Composite wire-mesh mist eliminator, (a) single layer, (b) two-layer pad, (c) four-layer pad, (d) eight-layer pad.

suggest how to install mist eliminators properly. Attention has been focused on identifying the maximum gas and liquid velocities to avoid flooding in working conditions and to evaluate separation efficiency.

Semiempirical equations based on the Souders-Brown relation are commonly used (York, 1954). However, this method of designing wire-mesh mist eliminators is very rough, because it does not take into account either the drop size, on which the collection efficiency is strongly dependent, or the liquid load that, as pointed out by York and Poppele (1963), can induce flooding of the pad.

Some articles in the last few years have shown that it is possible to predict separation performances based on a mechanistic description of the separation phenomena. Collection efficiency of impingement-type separators involves three different separation mechanisms: inertial, interception, and diffusion capture (Gerrard et al., 1986; Holmes and Chen, 1984; Feord et al., 1993). Holmes and Chen (1984) showed that only inertial capture plays an important role in separation efficiency for wire-mesh separators. This implies that the total separation efficiency can be evaluated only by taking into account the contribution due to inertial capture and neglecting interception and diffusion capture. Some relations have been published to evaluate the inertial capture efficiency for a single wire target, η_{ST} (Langmuir and Blodgett, 1946; Pich, 1966). All these relations agree that the inertial capture efficiency is a function of the Stokes number, St, defined as:

$$St = \frac{\rho_l \cdot u \cdot d_d^2}{18 \cdot \mu_g \cdot d_w}, \tag{1}$$

where u is the superficial gas velocity, ρ_l is the density of the liquid in the droplet, μ_g is the gas viscosity, and d_d and d_w indicate the droplet and target diameters, respectively.

Based on this analysis, separation efficiency of common wire-mesh mist eliminators can be evaluated by considering the separation efficiency of the single target and by taking into account the packing geometry. Brunazzi and Paglianti (1998) suggested the relation:

$$\eta_n = 1 - (1 - \eta_{ST})^M \cdot \left[1 - \eta_{ST} \cdot \frac{n - \bar{n} \cdot M}{\bar{n}}\right], \tag{2}$$

where M is the number of "reference" cells present in the pad, $\bar{n}$ is the number of layers necessary to fill each cell, and n is the number of layers that form the separator. M is computed as a function of n, and of the number of layers, $\bar{n}$:

$$M = \mathrm{int}\left[\frac{n}{\bar{n}}\right]. \tag{3}$$

The number of layers necessary to fill each cell is given by

$$\bar{n} = \frac{d_{eq}}{d_w}. \tag{4}$$

This can be evaluated if the geometric characteristic, d_{eq}, of the separator is known. From a geometrical analysis, Brunazzi and Paglianti (1998) suggested that

$$d_{eq} = \frac{4 \cdot \pi \cdot \epsilon}{a_e} \cdot \frac{d_w}{z} \tag{5}$$

where z is the distance between two successive layers, ϵ is the packing void fraction, and a_e its specific surface.

Finally, both the mechanistic model suggested by Brunazzi and Paglianti (1998) and the semiempirical equation proposed by Carpenter and Othmer (1955) can be used to compute the collection efficiency of common wire-mesh separators. Both of them correctly predict the separation efficiency of a separator if the pad is thicker than 65 mm. On the other hand some problems arise with thinner pads because the semiempirical equations available in the literature tend to underestimate their separation efficiency, while thinner pads are often used in multilayer separators. In fact, some new tendencies have emerged in the last few years in the development of wire-mesh-type collectors. Often the mist eliminator is made up of two or three metal mesh pads in series. Sometimes the first pad, made of fine wires, operates as a coalescer and is followed by a second pad that works as the actual separator. However, when high efficiency is required in the presence of a high entrained liquid load, a first pad, made from a low-density mesh, reduces the liquid load arriving at the second pad. This second pad can therefore have a higher density, assuring a high removal efficiency even for small droplet size.

Another important field of application where common wire-mesh mist eliminators can give some problems is the separation of droplets with dimensions of just a few microns. Bürkholz (1989) showed that if a pad made from 220 micron metal wire is used, high gas velocities and thus pressure drops as high as 20 mbar are necessary to obtain a dp_{50} of 1 micron. d_{50} is the diameter of the particles that can be sepa-

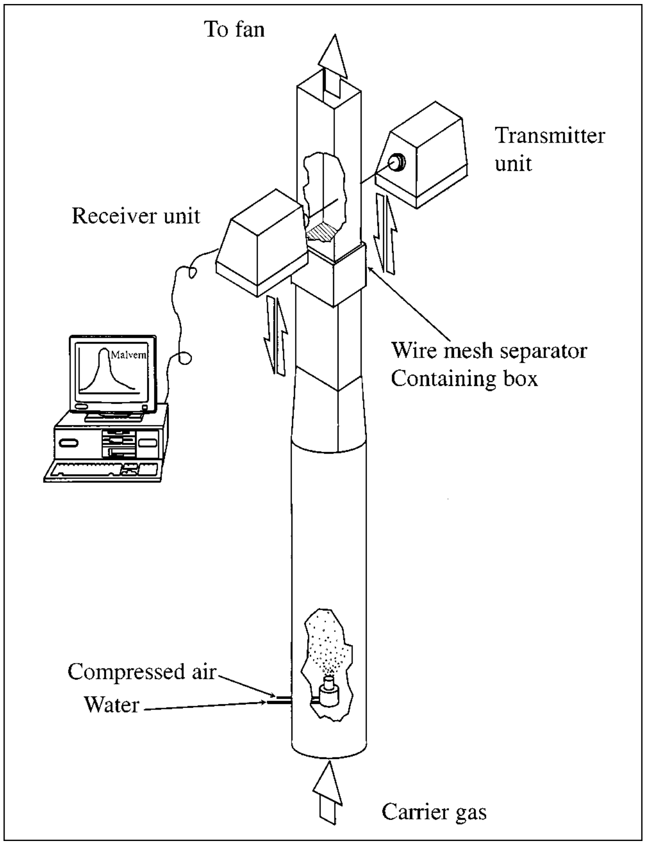

Figure 2. Experimental test apparatus.

rated with an efficiency greater than 50%. The same separation efficiency can be obtained with pressure drops as low as 2 mbar when wires of 4 microns are used. This experimental evidence shows that when liquid load is low, it is possible to obtain high separation efficiency, even for small droplets, while maintaining low pressure drops. Because the application just discussed requires thin pads, constructed from either metal wires or composite wires, already existing semiempirical equations and models cannot be used.

The Experimental Loop

Experimental collection efficiencies were determined as a function of droplet size and gas velocity in atmospheric working conditions in an experimental loop designed and built at the Chemical Engineering Department of the University of Pisa. For this purpose mist eliminators, furnished by Costacurta S.p.A. VICO, were tested. Air and water were used as working fluids. The experimental rig mainly consists of a spray-generation circuit and a carrier air circuit. The spray was generated using an ultrasonic nozzle fed by a volumetric pump, giving liquid flow rates ranging from 0 to 2600 L/h, and by a compressor supplying air at 6 atm at flow rates up to 280 Nm^3/h.

Table 1. Geometric Characteristics of Multilayer Packing

Style	Wire Dia. (mm)	Packing Dens. (kg/m^3)	Specific Area (m^2/m^3)	Void Fraction (-)	Pad Thick. (mm)
A	0.27	116	216	0.985	30
B	0.27	143	267	0.982	105
C	0.27	274	509	0.965	20

The test section, shown in Figure 2, consisted of a 3-m-long metal measuring section with a rectangular cross section, 120 mm wide and 190 mm high. The separator was installed horizontally with respect to the upflow of gas. A Malvern Particle Sizer instrument, based on measurements of the diffraction of an He-Ne laser beam by droplets moving through the measuring section, was used to accurately measure the total concentration and volumetric droplet distribution (Brunazzi and Paglianti, 1998). Acquisitions were carried out both upstream and downstream of the separator. Each datum represents the average of six different acquisitions. The accuracy of the measured efficiency is quite high and the maximum uncertainty of the measured efficiency is below 5%.

This article analyzes one metallic multilayer separator and several composite industrial wire-mesh mist eliminators. The metal wires used in all the tested separators are made in AISI 316. The composite separators tested in the present work are 50 mm thick. The main geometric characteristics of each packing are shown in Table 1 and Table 2, respectively. Fiber diameter, fiber material, and specific surface area were all varied in this work in order to investigate the influence of each parameter on the separation performance.

Simulation Model of Complex Wire-Mesh Behavior

The model that will be presented is based on the following hypotheses that were also used by Brunazzi and Paglianti

Table 2. Geometric Characteristics of Composite Packings

Style	Metal Wire Dia. (mm)	Fiber Dia. (μm)	Void Fraction	Metal Wt. (kg/m^3)	Fiber Wt. (kg/m^3)	Fiber Material
D	0.27	28	0.970	143.5	10.6	Polypropylene
E	0.27	28	0.958	143.5	21.8	Polypropylene
F	0.27	21	0.976	143.5	13.9	Teflon
G	0.27	22	0.971	143.5	15.3	Dacron
H	0.27	9	0.974	143.5	21.5	Glass fiber
I	0.27	9	0.965	143.5	44.2	Glass fiber
L	0.27	28	0.961	190	14	Polypropylene
M	0.27	28	0.944	190	28.8	Polypropylene
N	0.27	21	0.968	190	18.4	Teflon
O	0.27	22	0.961	190	20.2	Dacron
P	0.27	9	0.965	190	28.4	Glass fiber
Q	0.27	9	0.954	190	58.3	Glass fiber

(1998) for common wire-mesh mist eliminators: (a) no reentrainment, (b) no buildup of liquid, and (c) no mixing after passage through each layer. The first two hypotheses are also found in the model suggested by Carpenter and Othmer (1955), whereas the last hypothesis represents one of the differences between the present model and the work by Carpenter and Othmer (1955).

The model presented by Brunazzi and Paglianti (1998) suggested that the separator should be schematized as a series of reference cells. Notwithstanding its simplicity, the model allows a satisfactory prediction of separation efficiency to be made. However, its range of application is limited to common pads made from a single metal wire type and to homogeneous separators: therefore, it cannot be applied to predict separation efficiency of multilayers or composite mesh separators.

An extension of the model to predict multilayer efficiency can easily be performed. These new mist eliminators can be computed as a series of homogeneous pads. Therefore the total efficiency of the multilayer pad made by m pads can be computed as

$$\eta_t = 1 - \Pi_{i=1}^{m}(1-\eta_i), \tag{6}$$

where

$$\eta_i = 1 - \left(1-\eta_{ST_i}\right)^{M_i} \cdot \left[1 - \eta_{ST_i} \cdot \frac{n_i - \bar{n}_i \cdot M_i}{\bar{n}_i}\right], \tag{7}$$

and M_i is the number of "reference" cells present in the ith pad, $\bar{n}_i$ is the number of layers necessary to fill the cell of the ith pad, n_i is the number of layers that form the ith pad, and η_{ST_i} is the efficiency for a single wire target of the ith pad. The evaluation of the characteristic length of each layer, d_{eq_i}, can be made in the same way as for the common wire-mesh mist eliminator, because of their geometrical analogy.

While an extension of the model is quite easy for multilayer separators, it is more complex to define the geometrical characteristics of composite wire-mesh mist eliminators.

The vendors usually give the weight of metal wires for a unit volume of pad, w_m, and the weight of the fibers for a unit volume, w_f; therefore, the free volume and the surface area have to be evaluated. The length of metal wire, l_m, and of fiber, l_f, for a unit volume of the pad can be computed by geometrical analysis as

$$l_m = \frac{4 \cdot w_m}{\pi \cdot d_m^2 \cdot \rho_m}, \tag{8}$$

and

$$l_f = \frac{4 \cdot w_f}{\pi \cdot d_f^2 \cdot N_f \cdot \rho_f}, \tag{9}$$

where N_f is the number of single fibers that make up the nonmetallic monofilament, d_m and d_f are the metal wire diameter and the fiber diameter, respectively, and ρ_m and ρ_f are the metal and fiber densities.

The free volume of the composite pad, ϵ_c, can be evaluated as

$$(1-\epsilon_c) = \frac{\pi}{4} \cdot d_m^2 \cdot l_m + \frac{\pi}{4} \cdot d_f^2 \cdot N_f \cdot l_f = (1-\epsilon_m) \cdot \left[1 + N_f \cdot \left(\frac{d_f}{d_m}\right)^2 \cdot \frac{l_f}{l_m}\right], \tag{10}$$

where ϵ_m is the free volume of the metal pad supporting the nonmetallic fibers.

In a similar way, it is possible to evaluate the specific surface area of composite pad as

$$a_e = \pi \cdot d_m \cdot l_m + N_f \cdot \pi \cdot d_f \cdot l_f = a_m \cdot \left(1 + N_f \cdot \frac{d_f}{d_m} \cdot \frac{l_f}{l_m}\right), \tag{11}$$

where a_m is the specific surface area of the metal pad supporting the nonmetallic fibers.

Now, it is necessary to evaluate the diameter of an equivalent wire, d_e, that has the same length as the metal wire but shows the specific surface of the composite pad. The equivalence of the specific surface area gives

$$\pi \cdot d_e \cdot l_m = \pi \cdot d_m \cdot l_m + N_f \cdot \pi \cdot d_f \cdot l_f, \tag{12}$$

which can be rewritten as

$$d_e = d_m \cdot \left(1 + N_f \cdot \frac{d_f}{d_m} \cdot \frac{l_f}{l_m}\right). \tag{13}$$

The last parameter that has to be evaluated in order to use the mechanistic model suggested by Brunazzi and Paglianti (1998) represents the characteristic length, d_{eq}, of the reference cell. These authors defined this length as

$$d_{eq} = 4 \cdot \frac{\text{Cross section}}{\text{Wetted perimeter}}, \tag{14}$$

where the wetted perimeter is a function of the length of metal wire, l_m, of the packing cross section, A, and of the distance between two successive layers, z, and can be evaluated as

$$P_m = l_m \cdot A \cdot z. \tag{15}$$

For a composite mesh, the wetted perimeter has to be computed taking into account the presence of nonmetallic fibers, and therefore it can be evaluated as

$$P_c = P_m \cdot \left(1 + N_f \cdot \frac{d_f}{d_m} \cdot \frac{l_f}{l_m}\right). \tag{16}$$

Finally, the characteristic length of a composite mesh can be computed as

$$d_{eq} = 4 \cdot \frac{\text{Cross section}}{\text{Wetted perimeter}} = \frac{4 \cdot A \cdot \epsilon_c}{P_m \cdot \left(1 + N_f \cdot \frac{d_f}{d_m} \cdot \frac{l_f}{l_m}\right)} =$$

$$\frac{4 \cdot \epsilon_c}{l_m \cdot z \cdot \left(1 + N_f \cdot \frac{d_f}{d_m} \cdot \frac{l_f}{l_m}\right)} = \frac{4 \cdot \pi \cdot \epsilon_c \cdot d_m}{a_m \cdot z \cdot \left(1 + N_f \cdot \frac{d_f}{d_m} \cdot \frac{l_f}{l_m}\right)}. \quad (17)$$

Equation 7 makes it possible to compute the separation efficiency if the efficiency of a single target, η_{ST}, is known. As pointed out by Lucas (1983), the theoretical analysis by Langmuir and Blodgett (1946), which allows the evaluation of separation efficiency of a single target, can induce underestimation of the separation efficiency when it is applied to an array of targets that are close to each other. This effect is probably due to a mutual influence between single targets. By taking this experimental observation into account, Brunazzi and Paglianti (1998) showed that separation efficiency of a common wire-mesh mist eliminator can be properly evaluated if the following empirical relation is introduced as a closure equation: if

$$St \leq 1, \quad \text{then} \quad \eta_{ST} = St, \quad (18)$$

whereas, if

$$St \geq 1, \quad \text{then} \quad \eta_{ST} = 1, \quad (19)$$

the Stokes number being defined by Eq. 1. Therefore, the Stokes number can be easily evaluated for common wire-mesh mist eliminators and for metal multilayer pads. Using a similar approach to that suggested for a metal pad, the Stokes number for a composite mesh separator has been defined as

$$St = \frac{\rho_l \cdot u \cdot d_d^2}{18 \cdot \mu_g \cdot d_e}, \quad (20)$$

where the target diameter of the composite wire has been assumed to be equal to the equivalent wire diameter (see Eq. 17).

This simplifying hypothesis is justified by analysis of Figure 3, which shows a plot of all the experimental data obtained with composite separators. It can be noted that even if the specific surface area varies within the range of 1946–10,320 m^2/m^3, the experimental data obtained at Stokes numbers of greater than 1 display separation efficiencies of nearly 100%. These results agree with the experimental trends obtained by Brunazzi and Paglianti (1998) for pads made from a single metal wire.

Analysis of Experimental Results

When a gas/liquid separator has to be chosen, the first problem is to decide which kind of separator to use. If a separator made from a single type of wire is used, higher liquid removal efficiency can be obtained by increasing the density of the pad, but this can lead to flooding problems. Therefore, if a common pad made from a single type of wire is used, and if it has to work at high liquid loads, reentrainment problems can only be avoided by working at low gas velocity with a consequent lowering of removal efficiency.

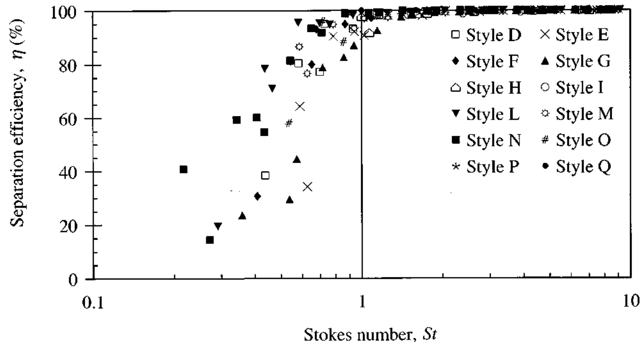

Figure 3. Separation efficiency vs. Stokes number.

All experimental data obtained with composite pads.

For instance, to avoid flooding of a pad, such as a York wire mesh mist eliminator type 931 in 18-8 stainless steel, the maximum liquid entrainment load is 4,564 kg/($m^2 \cdot h$) with an air velocity of 3.7 m/s (see York and Poppele, 1963). The separation performance of this pad can be evaluated using the model suggested by Brunazzi and Paglianti (1998), but to evaluate the nonseparated liquid rate, the liquid-drop distribution has to be known. If the liquid distribution is assumed to be equal to the distribution suggested by Garner et al. (1983) for steam–water evaporators, the liquid-drop concentration in the outlet stream is evaluated as 15.5 ppm. If a higher liquid separation efficiency is required, a more efficient pad has to be used but, as pointed out by York and Poppele (1963), flooding phenomena will occur. Multilayer separators can be the solution in this case (York, 1993). These collectors allow separation efficiency to be improved at high liquid loads, while maintaining the pressure drop low.

From the theoretical point of view, a multilayer separator can be analyzed as a series of single pads. Unfortunately, no experimental data on separation efficiency have been published yet. Figure 4 shows a comparison between present experimental data and the computed values obtained using the

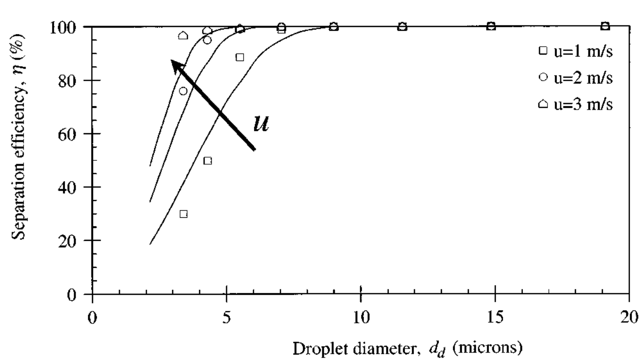

Figure 4. Separation efficiency of a multilayer pad vs. drop diameter.

Comparison between experimental measurements and the new model.

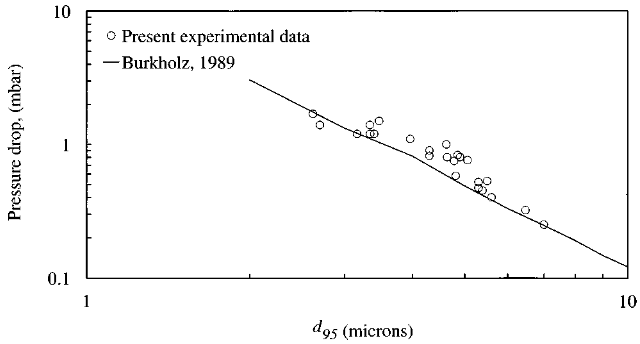

Figure 5. Pressure drop vs. d_{95}.

Comparison between present experimental measurements and Bürkholz's relation.

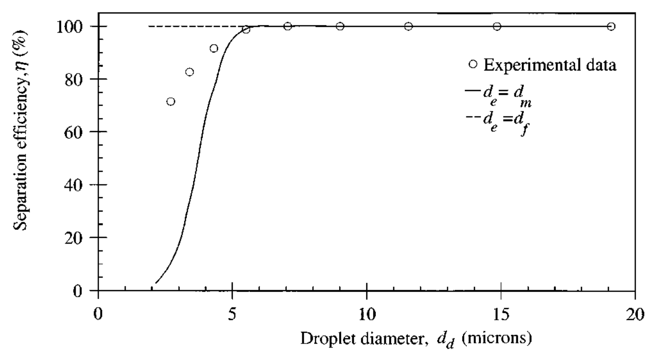

Figure 6. Separation efficiency vs. drop diameter.

Comparison between experimental measurements with the Carpenter and Othmer (1955) model using $d_e = d_m$ (continuous line) and $d_e = d_f$ (dashed line). Packing style H, 0.5 m/s superficial gas velocity, 50-mm pad thickness.

approach suggested in the present work. This figure shows that the model allows the separation efficiency to be evaluated with an acceptable degree of accuracy.

Using this model, it is thus possible to design or to optimize new separators that allow high separation efficiency even with high liquid entrainment loads. For instance, as pointed out before, when a 150-mm-thick York wire-mesh mist eliminator type 931 is used with a liquid load of 4564 $kg/(h \cdot m^2)$ and a gas velocity of 3.7 m/s, 15.5 ppm of liquid are still present in the gas phase downstream of the separator. But if a multilayer separator is used in a configuration consisting of 85 mm of the 931 type and 65 mm of the 421-type mist eliminator, for instance, the liquid load on the second pad can be evaluated as 0.36 $kg/(h \cdot m^2)$. Therefore flooding phenomena are avoided and a higher separation efficiency is achievable. In this case, a liquid concentration of 8.5 ppm in the gas phase downstream the separator has been estimated.

More interesting results can be obtained if composite pads are used. As pointed out by Bürkholz (1989), composite pads allow high separation efficiencies to be obtained even for small droplets. Unfortunately, few experimental data have been published on the separation performances of these types of separators. Bürkholz (1989) proposed a simple and reliable empirical way to estimate the diameter of the particles that can be separated with an efficiency greater than 95%, labeled d_{95}. He suggested plotting d_{95} against pressure drop to verify whether a relation linking these two parameters exists. Figure 5 shows a comparison between Bürkholz's relation and experimental data from the work presented in this article. It can be noted that the new data agree with the Bürkholz empirical relation (1989). From an empirical point of view, the equation suggested by Bürkholz (1989) can be used to predict d_{95}, but unfortunately no model has been developed to predict liquid separation efficiency of composite pads. Therefore, in order to predict the separation efficiency, some preexisting models, tested for single metal layers, have been modified. Most of the published equations refer to Carpenter and Othmer's model for common single metal wire pads. These authors suggested the following empirical equation:

$$\eta_n = 1 - \left(1 - \frac{2}{3} \cdot a_e \cdot \eta_{ST} \cdot \frac{z}{\pi}\right)^n, \qquad (21)$$

where a_e is the specific surface area of the separator, z the distance between two successive layers, n the number of layers, and η_{ST} the efficiency of a single target. Because η_{ST} is a function of the Stokes number, if the use of the equation is to be extended to a composite pad, it is necessary to define the diameter d_e. There are two possible choices: d_e can be assumed either equal to the metal wire diameter or equal to the fiber diameter. Figure 6 shows a comparison between the present experimental data and the Carpenter and Othmer model using the diameter of the metal wire, d_m, and the fiber, d_f, when defining the Stokes number. Analysis of the figure shows that the modified model by Carpenter and Othmer (1955) overestimates the separation efficiency when the fiber diameter is used in the Stokes number, whereas it largely underpredicts the measured efficiency when the metal wire diameter is used in the Stokes number. Therefore, Carpenter and Othmer's model cannot be extended to composite pads without introducing large errors in the prediction of the separation efficiency. At the same time, it was found that Carpenter and Othmer's model also induces large errors, even when the equivalent diameter suggested in the present work (Eq. 17) is used.

Figure 7 shows a comparison between the experimental data obtained in this article and the new model. The acquisi-

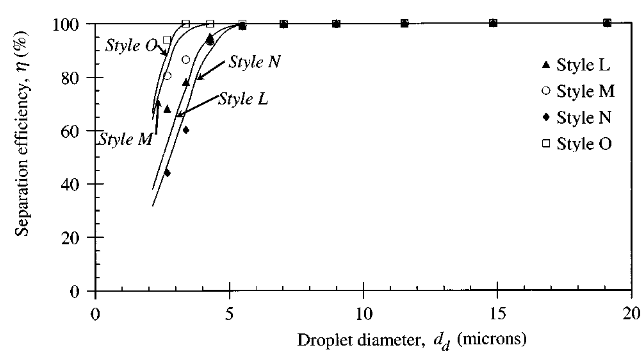

Figure 7. Separation efficiency vs. drop diameter, effect of specific surface.

Comparison between experimental measurements with the new model. Superficial gas velocity 0.75 m/s, 50-mm pad thickness (packing style M, ○; packing style O, □; packing style L, ▲; packing style N, ♦).

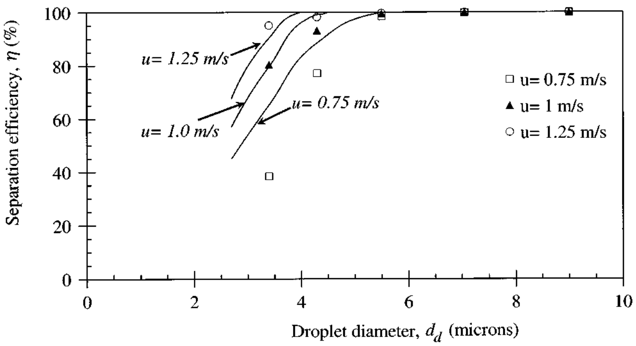

Figure 8. Separation efficiency vs. drop diameter, effect of superficial gas velocity.

Comparison between experimental measurements and the new model. Packing style D, 50-mm pad thickness.

tions refer to four packings with different geometrical properties, working at the same gas load. The specific surface of the separators was varied in the range of 1972–5209 m^2/m^3. It can be noted that the new model and experimental data agree for all the pads analyzed. Figure 8 shows a comparison between computed and measured efficiency of a pad working at different gas loads. Also in this case, the model presented in this article predicts the experimental performances of the separator with a sufficient degree of accuracy.

Finally, a parity plot is shown in Figure 9, which compares the experimental data obtained in this work and the computed values obtained using the present model. Analysis of the figure shows that the new model makes it possible to evaluate separation efficiency with sufficient accuracy for all the separators analyzed in this work, notwithstanding the fact that no adjustable parameters have been introduced.

Conclusions

The experimental data on droplet removal efficiency presented in this article were obtained using a laser-based droplet sizer, the Malvern Particle Sizer. This article has presented a new model for predicting removal efficiency of complex wire-mesh mist eliminators. Analysis of the experimental data obtained in this article shows that this new model can be used both for predicting separation efficiency of multilayer pads and to predict the separation efficiency of composite separators. The proposed model allows the measured efficiency to be predicted with sufficient accuracy even though no adjustable parameter has been used. This result is significant because no mechanistic model has yet been published in the literature to predict the separation efficiency of complex wire-mesh mist eliminators. This could be an important improvement, since an increasing number of industrial separators are composite or multilayers and only empirical relations are available to predict their separation efficiency. The new model presented in this article allows the contribution of each single pad, metallic or composite, to be evaluated, and could therefore be used for the design and the optimization of complex separation units.

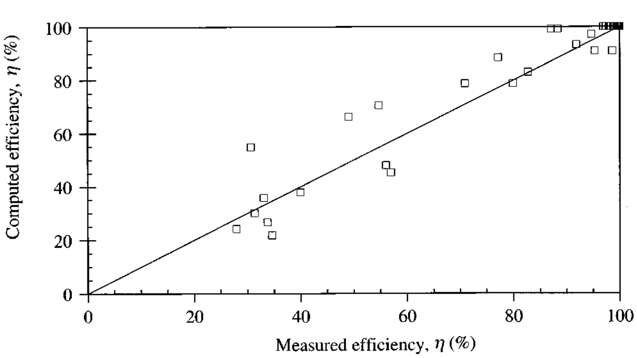

Figure 9. Separation efficiency.

Comparison between experimental measurements and the new model (composite pads).

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Notation

d_{eq} = equivalent diameter of the mesh
η_n = capture efficiency
π = 3.14159...
p = wire mesh packing
w = wire

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