TWA Limit Adjustments for Long Exposures

Longer exposures, e.g. work calls that go beyond eight hours during a day or more than 40 hours a week, require an adjustment of the TWA Limit. In the North American entertainment industry there are three different models most often used to arrive at an adjusted TWA Limit for longer exposures. These are usually described as OSHA, Brief and Scala, and a variation on Brief and Scala written into the Occupational Health and Safety Regulation of British Columbia.

The simplest is what is described as the “OSHA model.” The OSHA chemical exposure regulations [29 CFR 29 CFR 1910.1000(a)(2), 1910.1000(b)(2), and 1910.1000(c)] all assume an 8-hour workday in a 40-hour week and say nothing about longer shifts or more days worked in a week, but the “OSHA model” extrapolates from that 8-hour/40-hour week limits with the assumption that as long as a worker on a longer shift is not exposed to more material than the worker would be if working an 8-hour shift, all will be well. That is, a worker could be in a 5 mg/m^3 TWA concentration for 16 hours and it would be the equivalent to 8 hours in 10 mg/m^3. The simple formula is:

Adjusted TWA Limit = (8 hours/actual hours) x 8-hour TWA Limit

The OSHA model is simple, but usually it is not recommended by industrial hygienists. It ignores the need for any time for the body to recover from the exposure by metabolizing or expelling the chemicals. Instead, the Brief and Scala model is most often recommended. It looks at how much time in the day or week a person is not exposed to the chemicals and makes adjustments based on that. There are two formulas for arriving at an appropriate TWA Limit reduction factor; one is for longer days, and the other is for longer work-weeks. If either could be applied, you use the one that yields the greatest reduction factor.

For longer work-days:

RF = 8/T x ((24-T)/16)

Where:
RF = Reduction Factor
T = time in hours worked per shift

For longer work-weeks:

RF = 40/T x ((168-T)/128)

Where:
RF = Reduction Factor
T = time in hours worked per week

If someone were working in glycol fog for 12 hours a day, five days a week, the OSHA model should have the TWA Limit reduced from 10 mg/m^3 to 6.7 mg/m^3. Using the Brief and Scala model, the TWA Limit should drop to 5 mg/m^3.

There is a third method, and it's the one required in British Columbia. Section 5.50(1) of the OHS Regulation in that Canadian province has a table of reduction factors that must be used for work-shifts longer than eight hours:

Reduction Factor	Length of work period (in hours)
0.7	More than 8, but not more than 10
0.5	More than 10, but not more than 12
0.25	More than 12, but not more than 16
0.1	More than 16

If you do the math you will see that these Reduction Factors are the Reduction Factors for 10, 12, and 16 hours derived from the Brief and Scala model. The table is more conservative because the reduction factor for the

longest work-shift in a table row is applied to all the shorter shifts covered by that row. That is, the Reduction Factor for 10 hours is applied to anything over eight hours up to 10 hours, even to a work-shift exceeding eight hours by only a few minutes.

There are other models, but the Brief and Scala model, or the BC OHS Regulation derived from it, are the ones most often recommended by industrial hygienists giving advice on theatrical fog.