tent materials are described in the following subsection, along with the determinants and numerical values of the assimilation half-life used in World3.

The assimilation half-life AHL was defined as the time period, measured in years, over which half of the initial amount of persistent material will disappear from the environment. The assumption and definition may be stated mathematically:

Assumption: $$\frac{dPPOL(t)}{dt} = \frac{-PPOL(t)}{C}$$

Definition: $$PPOL(t = AHL) = \frac{PPOL(t = 0)}{2}$$

From equation (6.1): $$\frac{dPPOL(t)}{PPOL(t)} = \frac{-dt}{C}$$

$$\ln[PPOL(t)] = C' - \frac{t}{C}$$

$$PPOL(t) = [PPOL(t=0)]e^{-t/c}$$

From equations (6.2) and (6.3):

$$PPOL(t=AHL) = PPOL(t=0)e^{-\frac{AHL}{c}} = \frac{PPOL(t=0)}{2}$$

Thus: $e^{AHL/c} = 2$ or $AHL/c = \ln(2)$

and: $AHL/c = 0.7$

$c = 1.4\ AHL$

Therefore: $$\frac{dPPOL}{dt} = -PPOL/(1.4\,AHL)$$

Expressed in the DYNAMO format, equation (6.4) becomes:

```
PPASR.KL=PPOL.K/(AHL.K*1.4)                                144, R
   PPASR  - PERSISTENT POLLUTION ASSIMILATION RATE
            (POLLUTION UNITS/YEAR)
   PPOL   - PERSISTENT POLLUTION (POLLUTION UNITS)
   AHL    - ASSIMILATION HALF-LIFE (YEARS)
```

When the pollution appearance rate PPAPR is zero, one-half of the initial amount of persistent material will leave the environment over a time period equal to one assimilation half-life AHL; after an additional interval equal to AHL, one-fourth of the initial material will still remain, and so forth. The quantity remaining after the passage of a time interval equal to 7 half-lives will be less than 1 percent of the initial amount. Figure 6-17 illustrates the disappearance over time of 100 units of a persistent material with an assumed assimilation half-life of 1.5, 3, 5, and 90 years. Until the level of pollution has risen sufficiently to decrease the assimilative capacity of the environment, the numerical value for AHL employed in World3 is 1.5 years. As a consequence, when the pollution appearance rate is zero, half of the persistent materials will have disappeared from the World3 pollution level within 1.5 years of their appearance. So long as AHL equals 1.5 years, essentially all of the persistent pollutants will have been assimilated in World3 within 10 years after their appearance.

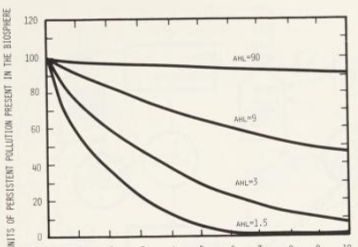

Figure 6-17 The assimilation of 100 units of persistent pollution with various values assumed for the assimilation half-life

Assimilation Half-Life AHL A basic postulate of the persistent pollution sector is that the rate of pollution assimilation at any point in time is directly proportional to the amount of pollution present in the global environment at that time. This assumption was used to derive the preceding expression for the persistent pollution assimilation rate PPASR. The half-life of the assimilation process need not be constant. In fact, the global average pollution assimilation half-life is affected by the composition of the existing pollution load, the geographical distribution of pollution, and the total amount of persistent pollution present in the environment. These three possible influences are discussed in this section to indicate the implications and the basis of our assumption in World3 that the assimilation half-life AHL is a variable that depends only on the level of the pollution present in the biosphere PPOL.

Because the global persistent pollution level will always be composed of materials with different half-lives, the real assimilation half-life will not be constant over time. Materials with very short half-lives disappear quickly. Thus the persistent pollution level PPOL will tend to become composed of materials with longer and longer assimilation half-lives.

This tendency may be illustrated by two simulation analyses of a very simple model of pollution accumulation and assimilation. The flow diagram of a model that simulates the decay of strontium-90 (Sr-90, half-life = 25 years) and molybdenum-93 (Mo-93, half-life = 2 years) is given in Figure 6-18. The program for the model is listed in the Appendix C to this chapter. Figure 6-19A presents a simulation of the model with no inputs of pollution and with initial values of 25 units of Sr-90 and 75 units of Mo-93. At first, the effective half-life of the total pollution level (Mo-93+Sr-90) is about 6 years. After 10 years, however, most of the persis-