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## PART 3

# Engineering Principles for Bioprocesses

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## *Operating Considerations for Bioreactors for Suspension and Immobilized Cultures*

### **9.1. INTRODUCTION**

So far we have discussed what cells are, how they work, and how to describe their growth in simple reactors. We now begin our discussion of how to use these cells in processes. We will explore some more complicated reactor strategies and why they might be considered for use in real processes. Chapter 10 will give more details on reactor design, and Chapter 11 will detail how to recover products from these reactors. These chapters should give the reader an understanding of how real bioprocesses can be assembled.

An important decision for constructing any process concerns the configuration the reactor system should take. The choice of reactor and operating strategy determines product concentration, number and types of impurities, degree of substrate conversion, yields, and whether sustainable, reliable performance can be achieved. Unlike many traditional chemical processes, the reactor section represents a very major component (usually  $> 50\%$ ) of the total capital expenditures. Choices at the reactor level and of the biocatalyst determine the difficulty of the separation. Thus, our choice of reactor must be made in the context of the total process: biocatalyst, reactor, and separation and purification train.