CEP Example Outline, as submitted by the author

USE CHEMICAL ENGINEERING TO REVAMP YOURSELF!

Outline for *Chemical Engineering Progress*
(submitted 31 January 2010)

Introduction

These days, many people are turning to expensive fitness professionals, dieticians and nutritionists to help them get into better shape. But in my experience, someone with a chemical engineering background can often use that knowledge to get just as good results – without the big price tag.

Yes, this probably sounds like quite a bold claim, but it really isn't. Chemical engineering is the science of transforming raw materials into quality products while minimising the formation of unwanted byproducts. And if you think about it for a moment, that's precisely what anyone wanting to get in better shape aims to do. The raw materials are foods, the finished product is lean muscle, and the unwanted byproduct is bodyfat. And consider this: What is the human body if not a highly complex network of reactors, separators, pipelines, storage vessels, heat exchangers and effluent systems?

In case you're still not convinced that there's a strong parallel, this article will illustrate how the basic concepts of chemical engineering can be directly applied to the challenge. Mass and energy balances, calorific values, selectivity, measurement and control… you name it, it's got an application. Believe it or not, there's even a way to use iron to catalyse the process!

Mass and energy balances

This first section of the article will look at daily energy consumption and expenditure and will explain how these relate to weight loss/gain. Essentially, it's an unsteady-state balance: In = Out + Accumulation. (In this case, the "Accumulation" term is visible and literal – it's the accumulation of bodyfat around the waist!)

It will then present an equation for estimating the metabolic energy demand and then using that to estimate the total daily expenditure. Next, it will explain how to calculate the total energy consumed – a simple task using tables of food nutrient contents. This will then

enable the reader to determine whether he or she is operating with an energy surplus or deficit.

Energy map

The next section of the article will present a graphical tool for illustrating the energy situation. This is a chart of energy expended vs. energy intake, with the individual's current performance plotted as an "operating point." It will then explain how anyone wishing to lose weight in a safe and healthy way should aim for a certain target line.

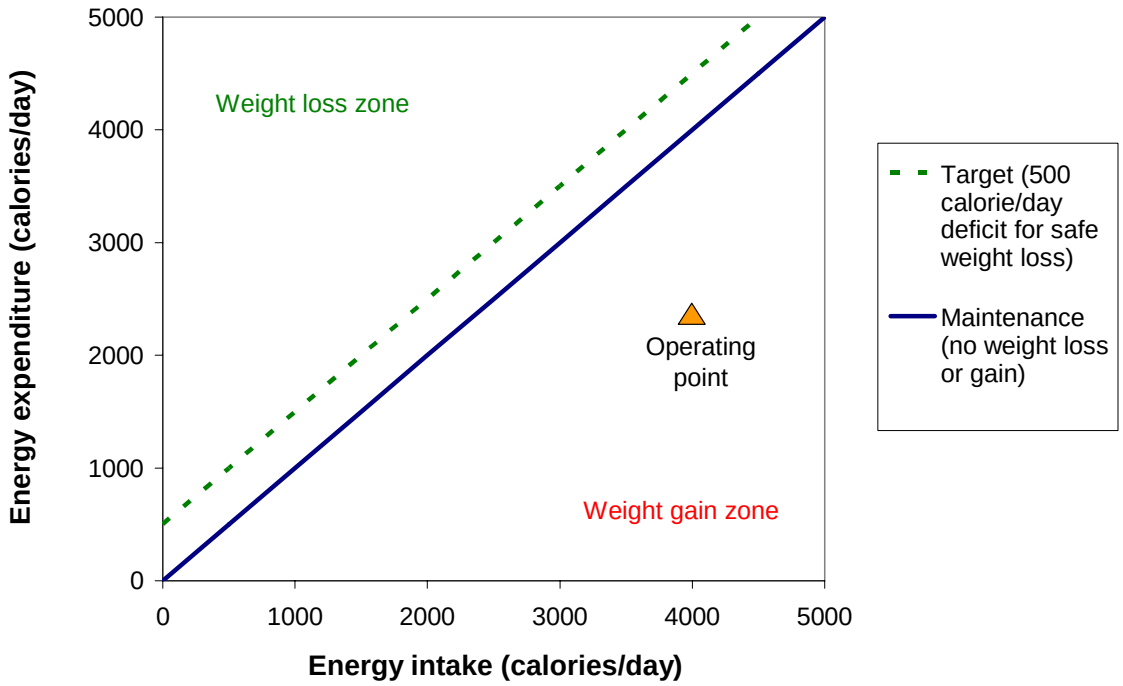

Figure 1: Example energy map

Finally, the optimum trajectory to move from the "operating point" to the target line will be examined. This is typically a combination of both diet and exercise, represented by a sloped line. A purely horizontal or vertical shift is typically not the best approach, and the reasons for this will be explained.

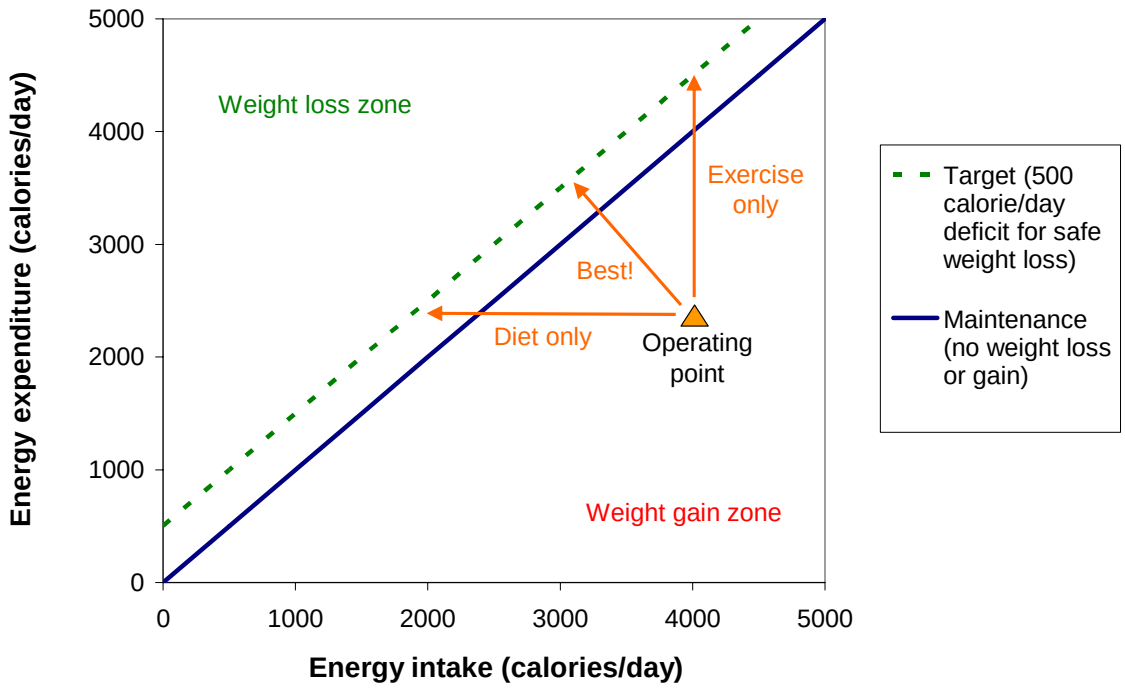

Figure 2: The optimum trajectory is a combination of diet and exercise

Selectivity

One of the reasons why a horizontal shift, i.e. reducing calories through "crash dieting," is not advised is because the weight reduction would come from a loss of both fat and muscle. In other words, the "selectivity" would be poor. The intention is to improve body composition by preferentially shedding *fat*, but maintaining muscle, and this section will explain how this can be accomplished. It will address the importance of exercise, and will also explain how to optimise the diet. Each meal should have a certain proportion of protein, fats and carbohydrates, and any second-year chemical engineering student will have the tools to structure this.

Use iron as a catalyst

This section will continue the topic of exercise introduced above. The use of iron here refers to "pumping iron," in other words, training with weights. The reader will learn how weight training brings several benefits which are not offered by other types of exercise. Firstly, it improves body composition by adding lean muscle. Secondly, the new muscle tissue is very metabolically active, and so the daily energy consumption will increase, helping to burn fat continuously. And finally, weight training stimulates the secretion of hormones which control the biochemical processes involved in burning fat. This section will also explain that weight

training is beneficial for both men and women, and will debunk the myth that it will turn people into bulky bodybuilders.

Calorific value calculations again

This section will expose some of the deceptive practices food manufacturers employ when marketing foods as "healthy options." It will show how chemical engineering enables one to see through these tricks by correctly analysing the food labels.

One real-life example is a fish pie whose packaging advertised, "Less than 3% fat!" However, some simple chemical engineering reveals that the real value (calculated from the label below) is closer to 25%!

Nutrition Facts
Per 100g

Calories	76
Protein	7.3g
Carbohydrate	7.3g
(of which sugar)	(3.2g)
Fat	1.9g
(of which saturated)	(0.9g)
Fibre	1.8g
Salt	0.3g

Figure 3: Food labels are a perfect opportunity to apply calorific vale calculations

Monitoring and control

Any chemical engineer working in a production environment knows how crucial process monitoring is. They'll no doubt have had the saying, "You can't manage what you don't measure" drilled into them. This section of the article will demonstrate that getting into better shape is no exception to this rule, and will show how to track progress and to make adjustments based on that.

It will first consider *what* should be tracked. Contrary to popular belief, this is not one's weight, and this can be explained using basic engineering principles. Because muscle is denser than fat, it's very possible to remain the same weight (or even become *heavier*), while at the same time getting leaner and smaller. The correct variable to track, therefore, is bodyfat content, and a simple formula for calculating this will be presented.

Then, the article will show a simple graphical method for tracking progress and comparing this with a plan. This method will allow any problems or deviations to be spotted quickly and nipped in the bud.

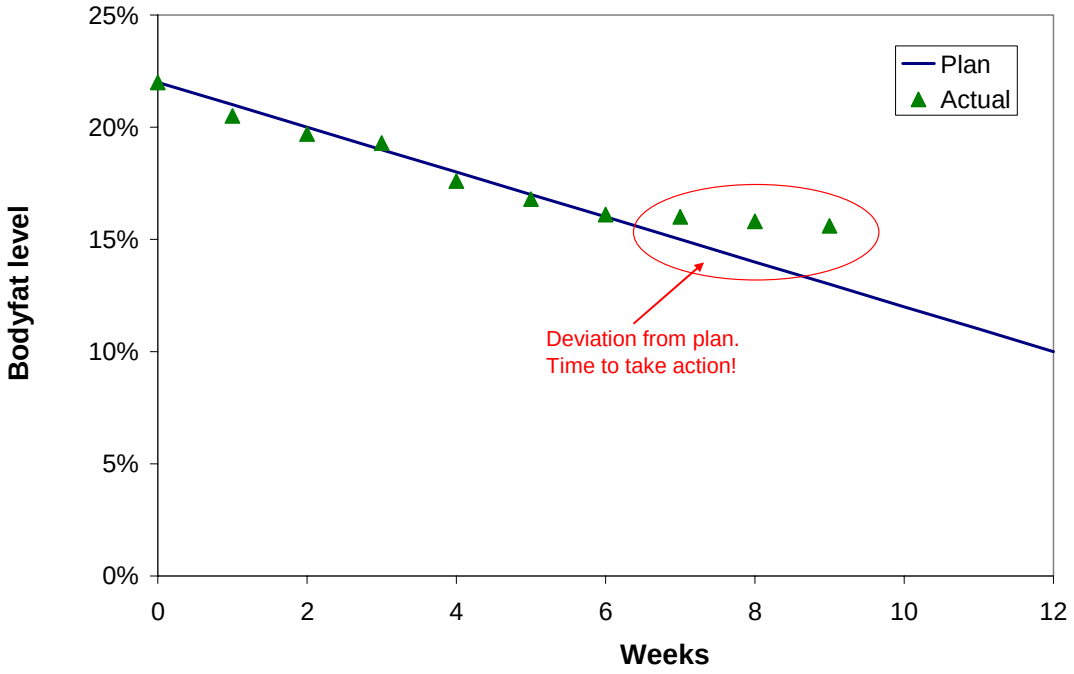

Figure 4: Regular process monitoring shows when you need to take action

Conclusion

So there you have it – the connection between chemical engineering and getting into better shape. The tools described in this article will allow you to bring a scientific approach to your efforts, rather than following someone else's advice blindly and just hoping for the best.

Of course, anyone working in the process industries knows that health and safety considerations are foremost, and this is certainly also the case here. That means you should aim for a gradual improvement which is sustainable. Don't be tempted by drastic measures and fad diets; these can often do more harm than good in the long term. And although my title is "Dr.", please be aware that this comes from my PhD in chemical engineering and that I'm not a medical doctor. You should consult your own doctor before putting any of the ideas in this article into practice.