**CHAPTER 16**

**COST ALLOCATION: JOINT PRODUCTS AND BYPRODUCTS**

**16-1** Exhibit 16-1 presents many examples of joint products from four different general industries. These include:

# Industry Separable Products at the Splitoff Point

Food Processing:

• Lamb • Lamb cuts, tripe, hides, bones, fat

• Turkey • Breasts, wings, thighs, poultry meal

Extractive:

• Petroleum • Crude oil, natural gas

**16-2** A *joint cost* is a cost of a production process that yields multiple products simultaneously. A s*eparable cost* is acost incurred beyond the splitoff point that is assignable to each of the specific products identified at the splitoff point.

**16-3** The distinction between a joint product and a byproduct is based on relative sales value. A *joint product* is a product from a joint production process (a process that yields two or more products) that has a relatively high total sales value. A *byproduct* is a product that has a relatively low total sales value compared to the total sales value of the joint (or main) products.

**16-4** A *product* is any output that has a positive sales value (or an output that enables a company to avoid incurring costs). In some joint-cost settings, outputs can occur that do not have a positive sales value. The offshore processing of hydrocarbons yields water that is recycled back into the ocean as well as yielding oil and gas. The processing of mineral ore to yield gold and silver also yields dirt as an output, which is recycled back into the ground.

**16-5** The chapter lists the following six reasons for allocating joint costs:

1. Computation of inventoriable costs and cost of goods sold for financial accounting purposes and reports for income tax authorities.

2. Computation of inventoriable costs and cost of goods sold for internal reporting purposes.

3. Cost reimbursement under contracts when only a portion of a business’s products or services is sold or delivered under cost-plus contracts.

4. Insurance settlement computations for damage claims made on the basis of cost information of joint products or byproducts.

1. Rate regulation when one or more of the jointly produced products or services are subject to price regulation.
2. Litigation in which costs of joint products are key inputs.

**16-6** The joint production process yields individual products that are either sold this period or held as inventory to be sold in subsequent periods. Hence, the joint costs need to be allocated between total production rather than just those sold this period.

**16-7** This situation can occur when a production process yields separable outputs at the splitoff point that do not have selling prices available until further processing. The result is that selling prices are not available at the splitoff point to use the sales value at splitoff method. Examples include processing in integrated pulp and paper companies and in petro-chemical operations.

**16-8** Both methods use market selling-price data in allocating joint costs, but they differ in which sales-price data they use. The *sales value at splitoff method* allocates joint costs to joint products on the basis of the relative total sales value at the splitoff point of the total production of these products during the accounting period. The *net realizable value method* allocates joint costs to joint products on the basis of the relative net realizable value (the final sales value minus the separable costs of production and marketing) of the total production of the joint products during the accounting period.

**16-9**  Limitations of the physical measure method of joint-cost allocation include:

a. The physical weights used for allocating joint costs may have no relationship to the revenue-producing power of the individual products.

1. The joint products may not have a common physical denominator––for example, one may be a liquid while another a solid with no readily available conversion factor.

**16-10** The NRV method can be simplified by assuming (a) a standard set of post-splitoff point processing steps and (b) a standard set of selling prices. The use of (a) and (b) achieves the same benefits that the use of standard costs does in costing systems.

**16-11** The constant gross-margin percentage NRV method takes account of the post-splitoff point “profit” contribution earned on individual products, as well as joint costs, when making cost assignments to joint products. In contrast, the sales value at splitoff point and the NRV methods allocate only the joint costs to the individual products.

**16-12** No. Any method used to allocate joint costs to individual products that is applicable to the problem of joint product-cost allocation should not be used for management decisions regarding whether a product should be sold or processed further. When a product is an inherent result of a joint process, the decision to process further should not be influenced by either the size of the total joint costs or by the portion of the joint costs assigned to particular products. Joint costs are irrelevant for these decisions. The only relevant items for these decisions are the incremental revenue and the incremental costs beyond the splitoff point.

**16-13**  No. The only relevant items are incremental revenues and incremental costs when making decisions about selling products at the splitoff point or processing them further. Separable costs are not always identical to incremental costs. Separable costs are costs incurred beyond the splitoff point that are assignable to individual products. Some separable costs may not be incremental costs in a specific setting (e.g., allocated manufacturing overhead for post-splitoff processing that includes depreciation).

**16-14** Two methods to account for byproducts are:

a. Production method—recognizes byproducts in the financial statements at the time production is completed.

1. Sales method—delays recognition of byproducts until the time of sale.

**16-15** The sales byproduct method enables a manager to time the sale of byproducts to affect reported operating income. A manager who was below the targeted operating income could adopt a “fire-sale” approach to selling byproducts so that the reported operating income exceeds the target. This illustrates one dysfunctional aspect of the sales method for byproducts.

**16-16** (20-30 min.)  **Joint-cost allocation, insurance settlement.**

1. (a) Sales value at splitoff method:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Pounds**  **of**  **Product** | **Wholesale**  **Selling Price**  **per Pound** | **Sales**  **Value**  **at Splitoff** | **Weighting:**  **Sales Value**  **at Splitoff** | **Joint**  **Costs**  **Allocated** | **Allocated**  **Costs per**  **Pound** |
| Breasts  Wings  Thighs  Bones  Feathers | 100  20  40  80  10  250 | $0.55  0.20  0.35  0.10  0.05 | $55.00  4.00  14.00  8.00  0.50  $81.50 | 0.675  0.049  0.172  0.098  0.006  1.000 | $33.75  2.45  8.60  4.90  0.30  $50.00 | 0.3375  0.1225  0.2150  0.0613  0.0300 |

*Costs of Destroyed Product*

Breasts: $0.3375 per pound × 40 pounds = $13.50

Wings: $0.1225 per pound × 15 pounds = 1.84

$15.34

b. Physical measure method:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Pounds**  **of**  **Product** | **Weighting:**  **Physical Measures** | **Joint**  **Costs**  **Allocated** | **Allocated Costs per Pound** |
| Breasts  Wings  Thighs  Bones  Feathers | 100  20  40  80  10  250 | 0.400  0.080  0.160  0.320  0.040  1.000 | $20.00  4.00  8.00  16.00  2.00  $50.00 | $0.200  0.200  0.200  0.200  0.200 |

*Costs of Destroyed Product*

Breast: $0.20 per pound × 40 pounds = $ 8

Wings: $0.20 per pound × 15 pounds = 3

$11

*Note*: Although not required, it is useful to highlight the individual product profitability figures:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | **Sales Value at**  **Splitoff Method** | | **Physical**  **Measures Method** | |
| **Product** | **Sales**  **Value** | **Joint Costs**  **Allocated** | **Gross**  **Income** | **Joint Costs**  **Allocated** | **Gross**  **Income** |
| Breasts  Wings  Thighs  Bones  Feathers | $55.00  4.00  14.00  8.00  0.50 | $33.75  2.45  8.60  4.90  0.30 | $21.25  1.55  5.40  3.10  0.20 | $20.00  4.00  8.00  16.00  2.00 | $35.00  0.00  6.00  (8.00)  (1.50) |

2. The sales value at splitoff method captures the benefits-received criterion of cost allocation and is the preferred method. The costs of processing a chicken are allocated to products in proportion to the ability to contribute revenue. Quality Chicken’s decision to process chicken is heavily influenced by the revenues from breasts and thighs. The bones provide relatively few benefits to Quality Chicken despite their high physical volume.

The physical measures method shows profits on breasts and thighs and losses on bones and feathers. Given that Quality Chicken has to jointly process all the chicken products, it is non-intuitive to single out individual products that are being processed simultaneously as making losses while the overall operations make a profit. Quality Chicken is processing chicken mainly for breasts and thighs and not for wings, bones, and feathers, while the physical measure method allocates a disproportionate amount of costs to wings, bones, and feathers.

**16-17** (10 min.) **Joint products and byproducts (continuation of 16-16).**

1. Ending inventory:

Breasts 15 × $0.3375 = $5.06

Wings 4 × 0.1225 = 0.49

Thighs 6 × 0.2150 = 1.29

Bones 5 × 0.0613 = 0.31

Feathers 2 × 0.0300 = 0.06

$7.21

2.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Joint products** | **Byproducts** |  | Net Realizable Values of byproducts: | |
| Breasts | Wings |  | Wings | $ 4.00 |
| Thighs | Bones |  | Bones | 8.00 |
|  | Feathers |  | Feathers | 0.50 |
|  |  |  |  | $12.50 |

Joint costs to be allocated:

Joint Costs – Net Realizable Values of Byproducts = $50 – $12.50 = $37.50

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Pounds of Product** | **Wholesale Selling Price per Pound** | **Sales Value at Splitoff** | **Weighting: Sales Value at Splitoff** | **Joint Costs Allocated** | **Allocated Costs Per Pound** |
| Breast | 100 | $0.55 | $55 | 55 ÷ 69 | $29.89 | $0.2989 |
| Thighs | 40 | 0.35 | 14 | 14 ÷ 69 | 7.61 | 0.1903 |
|  |  |  | $69 |  | $37.50 |  |

|  |  |
| --- | --- |
| Ending inventory: | |
| Breasts 15 × $0.2989 | $4.48 |
| Thighs 6 × 0.1903 | 1.14 |
|  | $5.62 |

3. Treating all products as joint products does not require judgments as to whether a product is a joint product or a byproduct. Joint costs are allocated in a consistent manner to all products for the purpose of costing and inventory valuation. In contrast, the approach in requirement 2 lowers the joint cost by the amount of byproduct net realizable values and results in inventory values being shown for only two of the five products, the ones (perhaps arbitrarily) designated as being joint products.

**16-18** (10 min.) **Net realizable value method.**

A diagram of the situation is in Solution Exhibit 16-18.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Corn Syrup** | **Corn Starch** | **Total** |
| Final sales value of total production, |  |  |  |
| 13,000 × $51; 5,900 × $26 | $663,000 | $153,400 | $816,400 |
| Deduct separable costs | 406,340 | 97,060 | 503,400 |
| Net realizable value at splitoff point | $256,660 | $ 56,340 | $313,000 |
| Weighting, $256,660; $56,340  $313,000 | 0.82 | 0.18 | 1.00 |
| Joint costs allocated, 0.82; 0.18 × $329,000 | $269,780 | $ 59,220 | $329,000 |

**Solution Exhibit 16-18** (all numbers are in thousands)



**16-19** (40 min.) **Alternative joint-cost-allocation methods, further-process decision.**

A diagram of the situation is in Solution Exhibit 16-19.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. |  | **Methanol** | **Turpentine** | **Total** |

Physical measure of total production (gallons) 2,500 7,500 10,000

Weighting, 2,500; 7,500  10,000 0.25 0.75

Joint costs allocated, 0.25; 0.75 × $120,000 $ 30,000 $ 90,000 $120,000

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 2. |  | **Methanol** | **Turpentine** | **Total** |

Final sales value of total production,

2,500 × $21.00; 7,500 × $14.00 $ 52,500 $105,000 $157,500

Deduct separable costs,

2,500 × $3.00; 7,500 × $2.00 7,500 15,000 22,500

Net realizable value at splitoff point $ 45,000 $ 90,000 $135,000

Weighting, $45,000; $90,000  $135,000 1/3 2/3

Joint costs allocated, 1/3; 2/3 × $120,000 $ 40,000 $ 80,000 $120,000

3. a. Physical-measure (gallons) method:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Methanol** | **Turpentine** | **Total** |

Revenues $52,500 $105,000 $157,500

Cost of goods sold:

Joint costs 30,000 90,000 120,000

Separable costs 7,500 15,000 22,500

Total cost of goods sold 37,500 105,000 142,500

Gross margin $15,000 $ 0 $ 15,000

b. Estimated net realizable value method:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Methanol** | **Turpentine** | **Total** |

Revenues $52,500 $105,000 $157,500

Cost of goods sold:

Joint costs 40,000 80,000 120,000

Separable costs 7,500 15,000 22,500

Total cost of goods sold 47,500 95,000 142,500

Gross margin $ 5,000 $ 10,000 $ 15,000

4.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Alcohol Bev.** | **Turpentine** | **Total** |

Final sales value of total production,

2,500 × $60.00; 7,500 × $14.00 $150,000 $105,000 $255,000

Deduct separable costs,

(2,500 × $12.00) + (0.20 × $150,000);

7,500 × $2.00 60,000 15,000 75,000

Net realizable value at splitoff point $ 90,000 $ 90,000 $180,000

Weighting, $90,000; $90,000  $180,000 0.50 0.50

Joint costs allocated, 0.5; 0.5 × $120,000 $ 60,000 $ 60,000 $120,000

An incremental approach demonstrates that the company should use the new process:

Incremental revenue,

($60.00 – $21.00) × 2,500 $ 97,500

Incremental costs:

Added processing, $9.00 × 2,500 $22,500

Taxes, (0.20 × $60.00) × 2,500 30,000 (52,500)

Incremental operating income from

further processing $ 45,000

Proof: Total sales of both products $255,000

Joint costs 120,000

Separable costs 75,000

Cost of goods sold 195,000

New gross margin 60,000

Old gross margin 15,000

Difference in gross margin $ 45,000

**Solution Exhibit 16-19**



**16-20** (40 min.) **Alternative methods of joint-cost allocation, ending inventories.**

Total production for the year was:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Ending** | **Total** |
|  | **Sold** | **Inventories** | **Production** |

X 68 132 200

Y 480 120 600

Z 672 28 700

A diagram of the situation is in Solution Exhibit 16-20.

1. a. Net realizable value (NRV) method:

**X Y Z Total**

Final sales value of total production,

200 × $1,200; 600 × $900; 700 × $600 $240,000 $540,000 $420,000 $1,200,000

Deduct separable costs –– –– 200,000 200,000

Net realizable value at splitoff point $240,000 $540,000 $220,000 $1,000,000

Weighting, $240; $540; $220  $1,000 0.24 0.54 0.22

Joint costs allocated,

0.24, 0.54, 0.22 × $580,000 $139,200 $313,200 $ 127,600 $ 580,000

Ending Inventory Percentages:

**X Y Z**

Ending inventory 132 120 28

Total production 200 600 700

Ending inventory percentage 66% 20% 4%

*Income Statement*

**X Y Z Total**

Revenues,

68 × $1,200; 480 × $900; 672 × $600 $81,600 $432,000 $403,200 $916,800

Cost of goods sold:

Joint costs allocated 139,200 313,200 127,600 580,000

Separable costs –– –– 200,000 200,000

Production costs 139,200 313,200 327,600 780,000

Deduct ending inventory,

66%; 20%; 4% of production costs 91,872 62,640 13,104 167,616

Cost of goods sold 47,328 250,560 314,496 612,384

Gross margin $ 34,272 $181,440 $ 88,704 $304,416

Gross-margin percentage 42% 42% 22%

b. Constant gross-margin percentage NRV method:

*Step 1:*

Final sales value of prodn., (200 × $1,200) + (600 × $900) + (700 × $600) $1,200,000

Deduct joint and separable costs, $580,000 + $200,000 780,000

Gross margin $ 420,000

Gross-margin percentage, $420,000 ÷ $1,200,000 35%

*Step 2:*

**X Y Z Total**

Final sales value of total production,

250 × $1,800; 300 × $1,300; 350 × $800 $240,000 $540,000 $420,000 $1,200,000

Deduct gross margin, using overall

Gross-margin percentage of sales, 35% 84,000 189,000 147,000 420,000

Total production costs 156,000 351,000 273,000 780,000

*Step 3:* Deduct separable costs — — 200,000 200,000

Joint costs allocated $156,000 $351,000 $ 73,000 $ 580,000

*Income Statement*

**X Y Z Total**

Revenues, 68 × $1,200;

480 × $900; 672 × $600 $81,600 $432,000 $403,200 $916,800

Cost of goods sold:

Joint costs allocated 156,000 351,000 73,000 580,000

Separable costs — — 200,000 200,000

Production costs 156,000 351,000 273,000 780,000

Deduct ending inventory,

66%; 20%; 4% of production costs 102,960 70,200 10,920 184,080

Cost of goods sold 53,040 280,800 262,080 595,920

Gross margin $ 28,560 $151,200 $141,200 $320,880

Gross-margin percentage 35% 35% 35% 35%

*Summary*  **X Y Z Total**

a. NRV method:

Inventories on balance sheet $91,872 $ 62,640 $ 13,104 $167,616

Cost of goods sold on income statement 47,328 250,560 314,496 612,384

$780,000

b. Constant gross-margin

percentage NRV method

Inventories on balance sheet $102,960 $ 70,200 $ 10,920 $184,080

Cost of goods sold on income statement 53,040 280,800 262,080 595,920

$780,000

2. Gross-margin percentages:

**X Y Z**

NRV method 42% 42% 22%

Constant gross-margin percentage NRV 35.0% 35.0% 35.0%

**Solution Exhibit 16-20**



**16-21** (30 min.) **Joint-cost allocation, process further.**



1a. Physical Measure Method

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Crude Oil** | **NGL** | **Gas** | **Total** |
| 1. Physical measure of total prodn.  2. Weighting (150; 50; 800 ÷ 1,000)  3. Joint costs allocated (Weights × $1,800) | 150  0.15  $270 | 50  0.05  $90 | 800  0.80  $1,440 | 1,000  1.00  $1,800 |

1b. NRV Method

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Crude Oil** | **NGL** | **Gas** | **Total** |
| 1. Final sales value of total production  2. Deduct separable costs  3. NRV at splitoff  4. Weighting (2,525; 645; 830 ÷ 4,000)  5. Joint costs allocated (Weights × $1,800) | $2,700  175  $2,525  0.63125  $1,136.25 | $750  105  $645  0.16125  $290.25 | $1,040  210  $ 830  0.20750  $373.50 | $4,490  490  $4,000  $1,800 |

2. The operating-income amounts for each product using each method is:

(a) Physical Measure Method

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Crude Oil** | **NGL** | **Gas** | **Total** |
| Revenues  Cost of goods sold  Joint costs  Separable costs  Total cost of goods sold  Gross margin | $2,700  270  175  445  $2,255 | $750  90  105  195  $555 | $1,040  1,440  210  1,650  $ (610) | $4,490  1,800  490  2,290  $2,200 |

(b) NRV Method

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Crude Oil** | **NGL** | **Gas** | **Total** |
| Revenues  Cost of goods sold  Joint costs  Separable costs  Total cost of goods sold  Gross margin | $2,700.00  1,136.25  175.00  1,311.25  $1,388.75 | $750.00  290.25  105.00  395.25  $354.75 | $1,040.00  373.50  210.00  583.50  $ 456.50 | $4,490.00  1,800.00  490.00  2,290.00  $2,200.00 |

1. Neither method should be used for product emphasis decisions. It is inappropriate to use joint-cost-allocated data to make decisions regarding dropping individual products, or pushing individual products, as they are joint by definition. Product-emphasis decisions should be made based on relevant revenues and relevant costs. Each method can lead to product emphasis decisions that do not lead to maximization of operating income.
2. Because crude oil is the only product subject to taxation, it is clearly in Sinclair’s best interest to use the NRV method because it leads to a lower profit for crude oil and, consequently, a smaller tax burden. A letter to the taxation authorities could stress the conceptual superiority of the NRV method. Chapter 16 argues that, using a benefits-received cost allocation criterion, market-based joint cost allocation methods are preferable to physical-measure methods. A meaningful common denominator (revenues) is available when the sales value at splitoff point method or NRV method is used. The physical-measures method requires nonhomogeneous products (liquids and gases) to be converted to a common denominator.

**16-22** (30 min.) **Joint-cost allocation, sales value, physical measure, NRV methods.**

1a.

|  |  |  |  |
| --- | --- | --- | --- |
| **PANEL A: Allocation of Joint Costs using Sales Value at**  **Splitoff Method** | **Special B/**  **Beef Ramen** | **Special S/ Shrimp Ramen** | **Total** |
| Sales value of total production at splitoff point |  |  |  |
| (20,000 tons  $5 per ton; 28,000  $20 per ton) | $100,000 | $560,000 | $660,000 |
| Weighting ($100,000; $560,000 ÷ $660,000) | 0.15 | 0.85 |  |
| Joint costs allocated (0.15; 0.85  $400,000) | $60,000 | $340,000 | $400,000 |
| **PANEL B: Product-Line Income Statement for June 2014** | **Special B** | **Special S** | **Total** |
| Revenues |  |  |  |
| (25,000 tons $17 per ton; 34,000 $33 per ton) | $425,000 | $1,122,000 | $1,547,000 |
| Deduct joint costs allocated (from Panel A) | 60,000 | 340,000 | 400,000 |
| Deduct separable costs | \_100,000 | 238,000 | 338,000 |
| Gross margin | $265,000 | $544,000 | $809,000 |
| Gross margin percentage | 62% | 48% | 52% |

1b.

|  |  |  |  |
| --- | --- | --- | --- |
| **PANEL A: Allocation of Joint Costs using Physical-Measure Method** | **Special B/**  **Beef Ramen** | **Special S/ Shrimp Ramen** | **Total** |
| Physical measure of total production (tons) | 20,000 | 28,000 | 48,000 |
| Weighting (20,000 tons; 28,000 tons ÷ 48,000 tons) | 42% | 58% |  |
| Joint costs allocated (0.42; 0.58  $400,000) | $168,000 | $232,000 | $400,000 |
| **PANEL B: Product-Line Income Statement for June 2014** | **Special B** | **Special S** | **Total** |
| Revenues |  |  |  |
| (25,000 tons $17 per ton; 34,000 $33 per ton) | $425,000 | $1,122,000 | $1,547,000 |
| Deduct joint costs allocated (from Panel A) | 168,000 | 232,000 | 400,000 |
| Deduct separable costs | 100,000 | 238,000 | 338,000 |
| Gross margin | $ 157,000 | $652,000 | $809,000 |
| Gross margin percentage | 37% | 58% | 52% |

1c.

|  |  |  |  |
| --- | --- | --- | --- |
| **PANEL A: Allocation of Joint Costs using Net Realizable**  **Value Method** | **Special B** | **Special S** | **Total** |
| Final sales value of total production during accounting period |  |  |  |
| (25,000 tons $17 per ton; 34,000 $33 per ton) | $425,000 | $1,122,000 | $1,547,000 |
| Deduct separable costs | 100,000 | 238,000 | 338,000 |
| Net realizable value at splitoff point | $325,000 | $884,000 | $1,209,000 |
| Weighting ($325,000; $884,000 ÷ $1,209,000) | 27% | 73% |  |
| Joint costs allocated (0.27; 0.73  $240,000) | $108,000 | $292,000 | $400,000 |
| **PANEL B: Product-Line Income Statement for June 2014** | **Special B** | **Special S** | **Total** |
| Revenues (25,000 tons $17 per ton; 34,000 $33 per ton) | $425,000 | $1,122,000 | $1,547,000 |
| Deduct joint costs allocated (from Panel A) | 108,000 | 292,000 | 400,000 |
| Deduct separable costs | 100,000 | 238,000 | 338,000 |
| Gross margin | $217,000 | $592,000 | $809,000 |
| Gross margin percentage | 51% | 53% | 52% |

2. Sandra Dashel probably performed the analysis shown below to arrive at the net loss of $2,435 from marketing the stock:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PANEL A: Allocation of Joint Costs using**  **Sales Value at Splitoff** | **Special B/**  **Beef Ramen** | **Special S/ Shrimp Ramen** | **Stock** | **Total** |
| Sales value of total production at splitoff point |  |  |  |  |
| (20,000 tons  $5 per ton; 28,000  $20 per  ton; 6,000  $4 per ton) | $100,000 | $560,000 | $24,000 | $684,000 |
| Weighting |  |  |  |  |
| ($100,000; $560,000; $24,000 ÷ $684,000) | 14.6199% | 81.8713% | 3.5088% | 100% |
| Joint costs allocated  (0.146199; 0.818713; 0.035088  $400,000) | $58,480 | $327,485 | $14,035 | $400,000 |
| **PANEL B: Product-Line Income Statement**  **for June 2014** | **Special B** | **Special S** | **Stock** | **Total** |
| Revenues |  |  |  |  |
| (25,000 tons  $17 per ton; 34,000  $33 per  ton; 6,000  $4 per ton) | $425,000 | $1,122,000 | $24,000 | $1,571,000 |
| Separable processing costs | 100,000 | 238,000 | 0 | 338,000 |
| Joint costs allocated (from Panel A) | 58,480 | 327,485 | 14,035 | 400,000 |
| Gross margin | $266,520 | $556,515 | $9,965 | $833,000 |
| Deduct marketing costs |  |  | 12,400 | 12,400 |
| Operating income |  |  | $ (2,435) | $820,600 |

In this (misleading) analysis, the $400,000 of joint costs are reallocated between Special B, Special S, and the stock. Irrespective of the method of allocation, this analysis is wrong. Joint costs are always irrelevant in a process-further decision. Only incremental costs and revenues past the splitoff point are relevant. In this case, the correct analysis is much simpler: The incremental revenues from selling the stock are $24,000, and the incremental costs are the marketing costs of $12,400. So, Fancy Foods should sell the stock—this will increase its operating income by $11,600 ($24,000 – $12,400).

**16-23** (20 min.)  **Joint cost allocation: sell immediately or process further.**

1.

a. Sales value at splitoff method:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Cookies/**  **Soymeal** | **Soyola/**  **Soy Oil** | **Total** |
| Sales value of total production at splitoff, |  |  |  |
| 575 lbs × $1.24; 160 gallons × $4.25 | $713 | $680 | $1,393 |
| Weighting, $713; $680  $1,393 | 0.512 | 0.488 |  |
| Joint costs allocated, |  |  |  |
| 0.512; 0.488 × $530 | $271 | $259 | $530 |
|  |  |  |  |

b. Net realizable value method:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Cookies** | **Soyola** | **Total** |
| Final sales value of total production, |  |  |  |
| 725 lbs × $2.24; 640 qts × $1.35 | $1,624 | $864 | $2,488 |
| Deduct separable costs | 380 | 240 | 620 |
| Net realizable value | $ 1,244 | $624 | $1,868 |
| Weighting, $1,244; $624$1,868 | 0.666 | 0.334 |  |
| Joint costs allocated, |  |  |  |
| 0.666; 0.334 × $530 | $ 353 | $177 | $ 530 |

2.

|  |  |  |
| --- | --- | --- |
|  | **Cookies/Soy Meal** | **Soyola/Soy Oil** |
| Revenue if sold at splitoff | $713a | $ 680 b |
| Process further NRV | 1,244 c | 624 d |
| Profit (Loss) from processing further | $531 | $(56) |

a 575 lbs × $1.24 = $713

b 160 gal × $4.25 = $680

c 725 lbs × $2.24 – $380 = $1,244

d 640 qts × $1.35 – $240 = $624

ISP should process the soy meal into cookies because that increases profit by $531 ($1,244 – $713). However, ISP should sell the soy oil as is, without processing it into the form of Soyola, because profit will be $56 ($680 – $624) higher if they do. Because the total joint cost is the same under both allocation methods, it is not a relevant cost to the decision to sell at splitoff or process further.

**16-24** (30 min.) **Accounting for a main product and a byproduct.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | **Production Method** | **Sales**  **Method** |
| 1. | Revenues |  |  |  |
|  | Main product |  | $682,240a | $682,240 |
|  | Byproduct |  | –– | 65,000d |
|  | Total revenues |  | 682,240 | 747,240 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Cost of goods sold  Total manufacturing costs |  | 500,000 | 500,000 |
|  | Deduct value of byproduct production |  | 85,000b | 0 |
|  | Net manufacturing costs |  | 415,000 | 500,000 |
|  | Deduct main product inventory |  | 74,700c | 90,000e |
|  | Cost of goods sold |  | 340,300 | 410,000 |
|  | Gross margin |  | $341,940 | $337,240 |

|  |  |
| --- | --- |
| a 42,640 × $16.00  b 8,500 × $10.00  c Inventory = 52,000 – 42,640 = 9,360 lbs;  (9,360/52,000) × $415,000 = $74,700 | d 6,500 × $10.00  e (9,360/52,000) × $500,000 = $90,000 |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **Production Method** | **Sales**  **Method** |
| 2. | Main Product | $74,700 | $90,000 |
|  | Byproduct | 20,000a | 0 |

|  |  |
| --- | --- |
| a Ending inventory shown at unrealized selling price.  BI + Production – Sales = EI  0 + 8,500 – 6,500 = 2,000 pounds  Ending inventory = 2,000 pounds × $10 per pound = $20,000 |  |

**16-25** (20 min.) **Joint costs and decision making.**

1. For analyzing the incremental value generated by rattles as a product line, the allocation of the cost of the snake (which is a joint cost) is irrelevant because it is sunk. The allocated overhead charge is also irrelevant because it represents Jack’s living expenses, which would be incurred regardless of the decision to sell (or not sell) rattles. So, the only relevant information in the financial results for rattles are the sales revenues of $2,200 and the traced processing expenses of $660. The incremental profit from selling rattles is given by:

Sales Revenues, $2,200 – Processing Expenses, $660 = $1,540.

Jack should therefore continue to sell rattles as dropping that product line would reduce his overall income by $1,540.

2. Jack purchases snakes at a unit cost of $11. Given the total snake cost of $26,400, this implies that Jack purchased a total of $26,400/$11 = 2,400 snakes this season. Jack’s incremental profit per rattle (given one rattle per snake and the incremental profit calculated in requirement 1 above) is therefore:

$1,540/2,400 = $0.64 per rattle

Because the miner is offering just $0.60 per rattle, Jack is better off processing and selling the rattles on his own.

**16-26** (35-45 min.) **Joint costs and byproducts.**

1. Computing byproduct deduction to joint costs:

Revenues from C, 16,000 × $6 $ 96,000

Deduct:

Gross margin, 10% of revenues 9,600

Marketing costs, 20% of revenues 19,200

Peanut Butter Department separable costs 12,000

Net realizable value (less gross margin) of C $ 55,200

Joint costs $180,000

Deduct byproduct contribution 55,200

Net joint costs to be allocated $124,800

**Deduct Net**

**Unit Final Separable Realizable Allocation of**

**Sales Sales Processing Value at $124,800**

**Quantity Price Value Cost Splitoff Weighting Joint Costs**

A 12,000 $12 $144,000 $27,000 $117,000 37.5% $ 46,800

B 65,000 3 195,000 –– 195,000 62.5% 78,000

Totals $339,000 $27,000 $312,000 $124,800

**Add Separable**

**Joint Costs Processing**

**Allocation Costs Total Costs Units Unit Cost**

A $ 46,800 $27,000 $ 73,800 12,000 $6.15

B 78,000 –– 78,000 65,000 1.20

Totals $124,800 $27,000 $151,800 77,000

Unit cost for C: $3.45 ($55,200 ÷ 16,000) + $0.75 ($12,000 ÷ 16,000) = $4.20,

or $6.00 – $0.60 (10% × $6) – $1.20 (20% × $6) = $4.20.

2. If all three products are treated as joint products:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Quantity** | **Unit Sales Price** | **Final Sales Value** | **Deduct Separable Processing Cost** | **Net Realizable Value at Splitoff** | **Weighting** | **Allocation of $180,000 Joint Costs** |
| A | 12,000 | $12 | $144,000 | $27,000 | $117,000 | 117 ÷ 376.8 | $ 55,892 |
| B | 65,000 | 3 | 195,000 | ─ | 195,000 | 195 ÷ 376.8 | 93,153 |
| C | 16,000 | 6 | 96,000 | 31,200 | 64,800 | 64.8 ÷ 376.8 | 30,955 |
| Totals |  |  | $435,000 | $58,200 | $376,800 |  | $180,000 |

**Add Separable**

**Joint Costs Processing**

**Allocation Costs Total Costs Units Unit Cost**

A $ 55,892 $27,000 $ 82,892 12,000 $6.91

B 93,153 –– 93,153 65,000 1.43

C 30,955 12,000 42,955 16,000 2.68

Totals $180,000 $39,000 $219,000 93,000

Call the attention of students to the different unit “costs” resulting from the two assumptions about the relative importance of Product C. The point is that costs of individual products depend heavily on which assumptions are made and which accounting methods and techniques are used.

**16-27** (25 min.) **Methods of joint-cost allocation, ending inventory.**

1. Net realizable value of human product:

(2,000 gallons × $585) – $120,000 = $1,050,000

Net realizable value of veterinarian product:

500 gallons × ($410 – $10) = $200,000

Joint costs: $60,000 + $90,000 = $150,000

Joint costs charged to human product:  = $126,000

Joint costs charged to veterinarian product:  = $24,000

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Human**  **Product** | **Vet**  **Product** | **Total** |
| Separable costs, |  |  |  |
| $120,000; 500 × $10 | $120,000 | $ 5,000 | $125,000 |
| Joint costs (from above) | 126,000 | 24,000 | 150,000 |
| Total costs | $246,000 | $29,000 | $275,000 |
| Units produced (gallons) | 2,000 | 500 | 2,500 |
| Cost per gallon |  |  |  |
| $246,000 ÷ 2,000; $29,000 ÷ 500 | $123 | $58 | $110 |
| Units in ending inventory (gallons)  Cost of ending inventory  $123 × 300; $58 × 200 | 300  $36,900 | 200  $11,600 | 500  $48,500 |

1. Final gross margin: NRV (Human) + NRV (Vet) – Joint costs

= $1,050,000 + $200,000 – $150,000 = $1,100,000

Final sales revenues: (2,000 × $585) + (500 × $410) = $1,375,000

Final gross margin percentage:  = 80%

By applying this constant gross margin percentage of 80% to both products, we can identify the amount of joint costs allocated to each product, as shown below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Constant gross-margin percentage NRV method** | **Human**  **Product** | **Vet**  **Product** | **Total** |
| Final sales value of production |  |  |  |
| $2,000 × 585; $410 × 500 | $1,170,000 | $205,000 | $1,375,000 |
| Gross Margin (80%) | 936,000 | 164,000 | 1,100,000 |
| Total costs | $ 234,000 | $ 41,000 | $ 275,000 |
| Separable costs | 120,000 | 5,000 | 125,000 |
| Joint costs | $ 114,000 | $ 36,000 | $ 150,000 |
|  |  |  |  |
|  |  |  |  |

1. In March, Tivoli sold 1,700 gallons for human use for a sales revenue of:

1,700 × $585 = $994,500

Under the constant gross-margin percentage NRV method, each product is provided a gross margin of 80%. Therefore, the gross margin for the sale of human product in March is:

$994,500 × 80% = $795,600

5. Revenue from accepting the offer: $6,000

Cost of modification (300 pints × $30): 9,000

Net Inflow: ($3,000)

Add: Cost saving from not having to dispose of

toxic byproduct 5,000

Total benefit from offer: $2,000

Tivoli should therefore accept the offer because its net income will increase by $2,000 as a result.

**16-28** (40 min.) **Alternative methods of joint-cost allocation, product-mix decisions.**

A diagram of the situation is in Solution Exhibit 16-28.

1. Computation of joint-cost allocation proportions:

a. **Sales Value of**

**Total Production Allocation of $105,000**

**at Splitoff Weighting Joint Costs**

A $ 75,000 75.0 ÷ 250 = 0.30 $ 31,500

B 62,500 62.5 ÷ 250 = 0.25 26,250

C 45,000 45.0 ÷ 250 = 0.18 18,900

D 67,500 67.5 ÷ 250 = 0.27 28,350

$250,000 1.00 $105,000

b.

**Physical Measure Allocation of $105,000**

**of Total Production Weighting Joint Costs**

A 275,000 gallons 275 ÷ 500 = 0.55 $ 57,750

B 100,000 gallons 100 ÷ 500 = 0.20 21,000

C 75,000 gallons 75 ÷ 500 = 0.15 15,750

D 50,000 gallons 50 ÷ 500 = 0.10 10,500

500,000 gallons 1.00 $105,000

c.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Final Sales**  **Value of**  **Total Production** | **Separable**  **Costs** | **Net Realizable Value at**  **Splitoff** | **Weighting** | **Allocation of**  **$105,000**  **Joint Costs** |
| Super A | $375,000 | $240,000 | $135,000 | 135 ÷ 300 = 0.45 | $ 47,250 |
| Super B | 150,000 | 60,000 | 90,000 | 90 ÷ 300 = 0.30 | 31,500 |
| C | 45,000 | – | 45,000 | 45 ÷ 300 = 0.15 | 15,750 |
| Super D | 75,000 | 45,000 | 30,000 | 30 ÷ 300 = 0.10 | 10,500 |
|  |  |  | $300,000 | 1.00 | $105,000 |

Computation of gross-margin percentages:

a. Sales value at splitoff method:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Super A** | **Super B** | **C** | **Super D** | **Total** |
| Revenues | $375,000 | $150,000 | $45,000 | $75,000 | $645,000 |
| Joint costs | 31,500 | 26,250 | 18,900 | 28,350 | 105,000 |
| Separable costs | 240,000 | 60,000 | 0 | 45,000 | 345,000 |
| Total cost of goods sold | 271,500 | 86,250 | 18,900 | 73,350 | 450,000 |
| Gross margin | $ 103,500 | $ 63,750 | $26,100 | $ 1,650 | $195,000 |
| Gross-margin percentage | 27.6% | 42.5% | 58.0% | 2.2% | 30.23% |

b. Physical-measure method:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Super A** | **Super B** | **C** | **Super D** | **Total** |
| Revenues | $375,000 | $150,000 | $45,000 | $75,000 | $645,000 |
| Joint costs | 57,750 | 21,000 | 15,750 | 10,500 | 105,000 |
| Separable costs | 240,000 | 60,000 | 0 | 45,000 | 345,000 |
| Total cost of goods sold | 297,750 | 81,000 | 15,750 | 55,500 | 450,000 |
| Gross margin | $ 77,250 | $ 69,000 | $29,250 | $19,500 | $195,000 |
| Gross-margin percentage | 20.6% | 46.0% | 65% | 26% | 30.23% |
|  |  |  |  |  |  |

c. Net realizable value method:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Super A** | **Super B** | **C** | **Super D** | **Total** |
| Revenues | $375,000 | $150,000 | $45,000 | $75,000 | $645,000 |
| Joint costs | 47,250 | 31,500 | 15,750 | 10,500 | 105,000 |
| Separable costs | 240,000 | 60,000 | 0 | 45,000 | 345,000 |
| Total cost of goods sold | 287,250 | 91,500 | 15,750 | 55,500 | 450,000 |
| Gross margin | $ 87,750 | $ 58,500 | $ 29,250 | $19,500 | $195,000 |
|  |  |  |  |  |  |
| Gross-margin percentage | 23.4% | 39.0% | 65.0% | 26.0% | 30.23% |
|  |  |  |  |  |  |

Summary of gross-margin percentages:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Joint-Cost** |  |  |  |  |
| **Allocation Method** | **Super A** | **Super B** | **C** | **Super D** |
| Sales value at splitoff | 27.6% | 42.5% | 58.0% | 2.2% |
| Physical measure | 20.6% | 46.0% | 65.0% | 26.0% |
| Net realizable value | 23.4% | 39.0% | 65.0% | 26.0% |

2. Further Processing of A into Super A:

Incremental revenue, $375,000 – $75,000 $300,000

Incremental costs 240,000

Incremental operating income from further processing $ 60,000

Further processing of B into Super B:

Incremental revenue, $150,000 – $62,500 $ 87,500

Incremental costs 60,000

Incremental operating income from further processing $ 27,500

Further Processing of D into Super D:

Incremental revenue, $75,000 – $67,500 $ 7,500

Incremental costs 45,000

Incremental operating loss from further processing $ (37,500)

Operating income can be increased by $37,500 if Product D is sold at its splitoff point rather than processing it further into Super D.

**Solution Exhibit 16-28**



**16-29** (40–60 min.) **Comparison of alternative joint-cost allocation methods, further-processing decision, chocolate products.**



1a. Sales value at splitoff method:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Chocolate-**  **Powder/**  **Liquor Base** | **Milk-**  **Chocolate/ Liquor Base** | **Total** |
| Sales value of total production at splitoff, |  |  |  |
| 700 × $20; 700 × $60 | $14,000 | $42,000 | $56,000 |
| Weighting, $14,000; $42,000  $56,000 | 0.25 | 0.75 |  |
| Joint costs allocated, |  |  |  |
| 0.25; 0.75 × $62,000 | $15,500 | $46,500 | $62,000 |
| Production cost per pound  [$15,500 + $50,100] ÷ 9,100;  [$46,500 + $60,115] ÷ 14,980 | $7.21 | $7.12 |  |
|  |  |  |  |

1b.

|  |  |  |  |
| --- | --- | --- | --- |
| Physical-measure method: |  |  |  |
| Physical measure of total production  (28,0002,000) × 50; 50 | 700 gallons | 700 gallons | 1,400 gallons |
| Weighting, 700; 7001,400 | 0.50 | 0.50 |  |
| Joint costs allocated, |  |  |  |
| 0.50; 0.50 × $62,000 | $31,000 | $31,000 | $62,000 |
| Production cost per pound  [$31,000 + $50,100] ÷ 9,100;  [$31,000 + $60,115] ÷ 14,980 | $8.91 | $6.08 |  |

1c. Net realizable value method:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Chocolate-**  **Powder** | **Milk-**  **Chocolate** | **Total** |
| Final sales value of total production, |  |  |  |
| 9,100 × $9; 14,980 × $10 | $81,900 | $149,800 | $231,700 |
| Deduct separable costs | 50,100 | 60,115 | 110,215 |
| Net realizable value at splitoff point | $31,800 | $89,685 | $121,485 |
| Weighting, $31,800; $89,685$121,485 | 0.2618 | 0.7382 |  |
| Joint costs allocated, |  |  |  |
| 0.2618; 0.7382 × $62,000 | $16,232 | $45,768 | $62,000 |
| Production cost per pound  [$16,232 + $50,100] ÷ 9,100;  [$45,768 + $60,115] ÷ 14,980 | $7.29 | $7.07 |  |

1d. Constant gross-margin percentage NRV method:

*Step 1:*

Final sales value of total production, (9,100 × $9; 14,980 × $10) $231,700

Deduct joint and separable costs, ($62,000 + $50,100 + $60,115)172,215

Gross margin $ 59,485

Gross-margin percentage ($59,485 ÷ $231,700) 25.6733%

*Step 2:*

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Chocolate-** | **Milk-** |  |
|  | **Powder** | **Chocolate** | **Total** |
| Final sales value of total production, |  |  |  |
| 9,100 × $9; 14,980 × $10 | $81,900 | $149,800 | $231,700 |
| Deduct gross margin, using overall gross- |  |  |  |
| margin percentage of sales (25.6733%) | 21,026 | 38,459 | 59,485 |
| Total production costs | 60,874 | 111,341 | 172,215 |

|  |  |  |  |
| --- | --- | --- | --- |
| *Step 3:* |  |  |  |
|  |  |  |  |
| Deduct separable costs | 50,100 | 60,115 | 110,215 |
| Joint costs allocated | $10,774 | $ 51,226 | $ 62,000 |
|  |  |  |  |
| Production cost per pound  [$10,774 + $50,100] ÷ 9,100;  [$51,226 + $60,115] ÷ 14,980 | $6.69 | $7.43 |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 2. |  | **Chocolate-** | | **Milk-** | |  |
|  |  | **Powder** | | **Chocolate** | | **Total** |
| a. | Revenues (6,500 × $9; 13,500 × $10) | $58,500 | | $135,000 | | $193,500 |
|  | Cost of goods sold |  | |  | |  |
|  | Joint costs | 15,500 | | 46,500 | | 62,000 |
|  | Separable costs | 50,100 | | 60,115 | | 110,215 |
|  | Production costs | 65,600 | | 106,615 | | 172,215 |
|  | Deduct ending inventory  (2,600 × $7.21; 1,480 × $7.12) | 18,746 | | 10,538 | | 29,284 |
|  | Cost of goods sold | 46,854 | | 96,077 | | 72,931 |
|  | Gross margin | $11,646 | | $38,923 | | $50,569 |
|  |  |  | |  | |  |
|  | Gross-margin percentage | 19.9% | | 28.8% | |  |
|  |  |  | |  | |  |
| b. | Revenues | $58,500 | $135,000 | | $193,500 | | |
|  | Cost of goods sold |  |  | |  | | |
|  | Joint costs | 31,000 | 31,000 | | 62,000 | | |
|  | Separable costs | 50,100 | 60,115 | | 110,215 | | |
|  | Production costs | 81,100 | 91,115 | | 172,215 | | |
|  | Deduct ending inventory  (2,600 × $8.91; 1,480 × $6.08) | 23,166 | 8,998 | | 32,164 | | |
|  | Cost of goods sold | 57,934 | 82,117 | | 140,051 | | |
|  | Gross margin | $566 | $52,883 | | $53,449 | | |
|  |  |  |  | |  | | |
|  | Gross-margin percentage | 0.97% | 39.2% | |  | | |
|  |  |  |  | |  | | |
| c. | Revenues | $58,500 | $135,000 | | $193,500 | | |
|  | Cost of goods sold |  |  | |  | | |
|  | Joint costs | 16,232 | 45,768 | | 62,000 | | |
|  | Separable costs | 50,100 | 60,115 | | 110,215 | | |
|  | Production costs | 66,332 | 105,883 | | 172,215 | | |
|  | Deduct ending inventory  (2,600 × $7.29; 1,480 × $7.07) | 18,954 | 10,464 | | 29,418 | | |
|  | Cost of goods sold | 47,378 | 95,419 | | 142,797 | | |
|  | Gross margin | $11,122 | $39,581 | | $53,449 | | |
|  |  |  |  | |  | | |
|  | Gross-margin percentage | 19.0% | 29.3% | |  | | |
|  |  |  |  | |  | | |
| d. | Revenues | $58,500 | $135,000 | | $193,500 | | |
|  | Cost of goods sold |  |  | |  | | |
|  | Joint costs | 10,774 | 51,226 | | 62,000 | | |
|  | Separable costs | 50,100 | 60,115 | | 110,215 | | |
|  | Production costs | 60,874 | 111,341 | | 172,215 | | |
|  | Deduct ending inventory  (2,600 × $6.69; 1,480 × $7.43) | 17,394 | 10,996 | | 28,390 | | |
|  | Cost of goods sold | 43,480 | 100,345 | | 143,825 | | |
|  | Gross margin | $15,020 | $34,655 | | $49,675 | | |
|  |  |  |  | |  | | |
|  | Gross-margin percentage | 25.7% | 25.7% | |  | | |

3. Further processing of chocolate-powder liquor base into chocolate powder:

Incremental revenue, $81,900 – $14,000 ($20 × 700) $67,900

Incremental costs 50,100

Incremental operating income from further processing $17,800

Further processing of milk-chocolate liquor base into milk chocolate:

Incremental revenue, $149,800 – $42,000 ($60 × 700) $107,800

Incremental costs 60,115

Incremental operating income from further processing $ 47,685

Chocolate Factory should continue to process milk-chocolate liquor base into milk chocolate and chocolate-powder liquor base into chocolate powder.

**16-30** (30 min.) **Joint-cost allocation, process further or sell.**

A diagram of the situation is in Solution Exhibit 16-30.

1.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| a.Sales value at splitoff method. | | | | | | | |
|  | **Monthly Unit Output** | **Selling Price Per Unit** | **Sales Value**  **of Total Prodn. at Splitoff** |  | **Weighting** |  | **Joint Costs Allocated** |
| Studs (Building) | 82,000 | $ 6 | $492,000 |  | 53.48% |  | $545,496 |
| Decorative Pieces | 2,000 | 70 | 140,000 |  | 15.22 |  | $155,244 |
| Posts | 18,000 | 16 | 288,000 |  | 31.30 |  | $319,260 |
| Totals |  |  | $920,000 |  | 100.00% |  | $1,020,000 |
| b.Physical measure method. | | | | | | | |
|  |  |  | **Physical Measure of Total Prodn.** |  | **Weighting** |  | **Joint Costs Allocated** |
| Studs (Building) |  |  | 82,000 |  | 80.39% | $ | $ 819,978 |
| Decorative Pieces |  |  | 2,000 |  | 1.96 |  | 19,992 |
| Posts |  |  | 18,000 |  | 17.65 |  | 180,030 |
| Totals |  |  | 102,000 |  | 100.00% |  | $1,020,000 |
| c.Net realizable value method. | | | | | | | |
|  | **Monthly Units of Total Prodn.** | **Fully Processed Selling Price per Unit** | **Net Realizable Value at**  **Splitoff** |  | **Weighting** |  | **Joint Costs Allocated** |
| Studs (Building) | 82,000 | $ 6 | $492,000 |  | 56.68% | | $ 578,136 |
| Decorative Pieces | 1,800a | 110 | 88,000b |  | 10.14 |  | 103,428 |
| Posts | 18,000 | 16 | 288,000 |  | 33.18 |  | 338,436 |
| Totals |  |  | $868,000 |  | 100.00% | | $1,020,000 |
| a 2,000 monthly units of output – 10% normal spoilage = 1,800 good units.  b 1,800 good units × $110 = $198,000 – Further processing costs of $110,000 = $88,000 | | | | | | | |

2. Presented below is an analysis for Doughty Sawmill, Inc., comparing the processing of decorative pieces further versus selling the rough-cut product immediately at splitoff:

|  |  |  |
| --- | --- | --- |
|  | **Units** | **Dollars** |
| Monthly unit output | 2,000 |  |
| Less: Normal further processing shrinkage | 200 |  |
| Units available for sale | 1,800 |  |
| Final sales value (1,800 units × $110 per unit) |  | $198,000 |
| Less: Sales value at splitoff |  | (140,000) |
| Incremental revenue |  | 58,000 |
| Less: Further processing costs |  | (110,000) |
| Additional contribution from further processing |  | $ (52,000) |

3. Assuming Doughty Sawmill announces that in six months it will sell the rough-cut product at splitoff due to increasing competitive pressure, behavior that may be demonstrated by the skilled labor in the planning-and-sizing process include the following:

* Lower quality
* Reduced motivation and morale
* Job insecurity, leading to nonproductive employee time looking for jobs elsewhere.

Management actions that could improve this behavior include the following:

* Improve communication by giving the workers a more comprehensive explanation as to the reason for the change (and in particular the analysis in requirement 2 above) so they can better understand the situation and bring out a plan for future operation of the rest of the plant.
* The company can offer incentive bonuses to maintain quality and production and align rewards with goals and also share some of the savings from not processing the unfinished decorative pieces.
* The company could provide job relocation and internal job transfers.

**Solution Exhibit 16-30**

**16-31** (40 min.) **Joint-cost allocation.**

Processing

Splitoff

Point

Separable Costs

Decorative

Pieces

$110 per unit

Processing

$110,000

Studs

$6 per unit

Raw Decorative

Pieces

$70 per unit

Posts

$16 per unit

Joint Costs

$1,020,000

1.



a.

|  |  |  |  |
| --- | --- | --- | --- |
| Physical-measure method: |  |  |  |
|  | **Butter** | **Buttermilk** | **Total** |
| Physical measure of total production  (12,000 gal × 3; 12,000 gal × 9) | 36,000 cups | 108,000 cups | 144,000 cups |
| Weighting, 36,000; 108,000  144,000 | 0.25 | 0.75 |  |
| Joint costs allocated, |  |  |  |
| 0.25; 0.75 × $63,360 | $15,840 | $47,520 | $63,360 |

b. Sales value at splitoff method:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Butter** | **Buttermilk** | **Total** |
| Sales value of total production at splitoff,  18,000 lbs × $4.40; 27,000 quarts × $2.40 | $79,200 | $64,800 | $144,000 |
| Weighting, $79,200; $64,800  $144,000 | 0.55 | 0.45 |  |
| Joint costs allocated, |  |  |  |
| 0.55; 0.45 × $63,360 | $34,848 | $28,512 | $63,360 |
|  |  |  |  |

c. Net realizable value method:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Butter** | | **Buttermilk** | | **Total** | |
| Final sales value of total production, | |  | |  | |  | |
| 36,000 tubs × $4.60; 27,000 quarts × $2.40 | | $165,600 | | $64,800 | | $230,400 | |
| Deduct separable costs | | 57,600 | | 0 | | 57,600 | |
| Net realizable value | | $108,000 | | $64,800 | | $172,800 | |
| Weighting, $108,000; $64,800$172,800 | | 0.625 | | 0.375 | |  | |
| Joint costs allocated, | |  | |  | |  | |
| 0.625; 0.375 × $63,360 | | $39,600 | | $23,760 | | $63,360 | |

d. Constant gross-margin percentage NRV method:

*Step 1:*

Final sales value of total production (see 1c.) $230,400

Deduct joint and separable costs ($63,360 + $57,600) 120,960

Gross margin $109,440

Gross-margin percentage ($109,440 ÷ $230,400) 47.50%

*Step 2:*

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  | **Butter** | **Buttermilk** | **Total** |
| Final sales value of total production | $165,600 | $64,800 | $230,400 |
| Deduct gross margin, using overall |  |  |  |
| gross-margin percentage of sales (47.50%) | 78,660 | 30,780 | 109,440 |
| Total production costs | 86,940 | 34,020 | 120,960 |
|  |  |  |  |
| *Step 3:* |  |  |  |
| Deduct separable costs | 57,600 | 0 | 57,600 |
| Joint costs allocated | $29,340 | $34,020 | $63,360 |

2. Advantages and disadvantages:

- Physical-Measure

Advantage: Low information needs. Only knowledge of joint cost and physical distribution is needed.

Disadvantage: Allocation is unrelated to the revenue-generating ability of products.

- Sales Value at Splitoff

Advantage: Considers market value of products as basis for allocating joint cost. Relative sales value serves as a proxy for relative benefit received by each product from the joint cost.

Disadvantage: Uses selling price at the time of splitoff even if product is not sold by the firm in that form. Selling price may not exist for product at splitoff.

- Net Realizable Value

Advantages: Allocates joint costs using ultimate net value of each product; applicable when the option to process further exists

Disadvantages: High information needs; Makes assumptions about expected outcomes of future processing decisions

- Constant Gross-Margin percentage method

Advantage: Because it is necessary to produce all joint products, they all look equally profitable.

Disadvantages: High information needs. All products are not necessarily equally profitable; method may lead to negative cost allocations so that unprofitable products are subsidized by profitable ones.

1. When selling prices for all products exist at splitoff, the sales value at splitoff method is the preferred technique. It is a relatively simple technique that depends on a common basis for cost allocation—revenues. It is better than the physical method because it considers the relative market values of the products generated by the joint cost when seeking to allocate it (which is a surrogate for the benefits received by each product from the joint cost). Further, the sales value at splitoff method has advantages over the NRV method and the constant gross margin percentage method because it does not penalize managers by charging more for developing profitable products using the output at splitoff, and it requires no assumptions about future processing activities and selling prices.

**16-32** (10 min.) **Further processing decision (continuation of 16-31).**

1.and 2. The decision about which combination of products to produce is not affected by the method of joint cost allocation. For both the sales value at splitoff and physical measure methods, the relevant comparisons are as shown below:

|  |  |  |
| --- | --- | --- |
|  | **Butter** | **Buttermilk** |
| Revenue if sold at splitoff | $ 79,200 a | $64,800 b |
| Process further NRV | 108,000 c | 43,200 d |
| Profit (Loss) from processing further | $ 28,800 | $(21,600) |

a 18,000 lbs × $4.40 = $79,200

b 27,000 quarts × $2.40 = $64,800

c 36,000 tubs × $4.60 – 18,000 lbs × $3.20 = $108,000

d 54,000 pints × $1.50 – 54,000 pints × $0.70 = $43,200

To maximize profits, Clover should process butter further into spreadable butter. However, Clover should sell the buttermilk at the splitoff point in quart containers. The extra cost to convert to pint containers ($0.70 per pint × 2 pints per quart = $1.40 per quart) exceeds the increase in selling price ($1.50 per pint × 2 pints per quart = $3.00 per quart – $2.40 original price = $0.60 per quart) and leads to a loss of $21,600.

3. The decision to sell a product at split off or to process it further should have nothing to do with the allocation method chosen. For each product, you need to compare the revenue from selling the product at split off to the NRV from processing the product further. Other things being equal, management should choose the higher alternative. The total joint cost is the same regardless of the alternative chosen and is therefore irrelevant to the decision.

**16-33** (20 min.) **Joint-cost allocation with a byproduct.**

1. Sales value at splitoff method: Byproduct recognized at time of production method

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Floor Mats** | **Car Mats** | **Rubber Shreds (lbs)** |
| Products manufactured | 31,250a | 93,750b | 50,000c |
| Products sold | 25,000 | 85,000 | 43,000 |
| Ending inventory | 6,250 | 8,750 | 7,000 |

a 25 floor mats/100 tires = 0.25 floor mats per tire × 125,000 tires = 31,250 floor mats

b 75 car mats/100 tires = 0.75 car mats per tire × 125,000 tires = 93,750 car mats

c (125,000 tires/100) × 40 lbs = 50,000 lbs rubber shreds

Joint cost to be charged to joint products = Joint Cost – NRV of Byproduct

= $600,000 – (50,000 lbs × 0.70 per lb)

= $600,000 – $35,000

= $565,000

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Floor Mats** | **Car Mats** | **Total** |
| Sales value of mats at splitoff,  31,250 × $12; 93,750 × $6 | $ 375,000 | $ 562,500 | $937,500 |
| Weighting, $375,000; $562,500  $937,500 | 0.40 | 0.60 |  |
| Joint costs allocated, 0.40; 0.60 × $565,000 | $226,000 | $339,000 | $565,000 |

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Floor Mats** | **Car Mats** | **Total** |
| Revenues, 25,000 × $12; 85,000 × $6 | $ 300,000 | $ 510,000 | $ 810,000 |
| Cost of goods sold: |  |  |  |
| Joint costs allocated, 0.40; 0.60 × $565,000 | $226,000 | $339,000 | $565,000 |
| Less: Ending inventory | ( 45,200)b | ( 31,640)c | ( 76,840) |
| Cost of goods sold | $ 180,800 | $ 307,360 | $ 488,160 |
| Gross margin | $ 119,200 | $ 202,640 | $ 321,840 |

b 6,250 × $226,000/31,250 = $45,200

c 8,750 × $339,000/93,750 = $31,640

The ending inventory of rubber shreds is reported at its estimated market value of $4,900 (7,000 lbs × $0.70).

1. Sales value at splitoff method: Byproduct recognized at time of sale method

Joint cost to be charged to joint products = Joint Cost = $600,000

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Floor Mats** | **Car Mats** | **Total** |
| Sales value of mats at splitoff,  31,250 × $12; 93,750 × $6 | $ 375,000 | $ 562,500 | $937,500 |
| Weighting, $375,000; $562,500  $937,500 | 0.40 | 0.60 |  |
| Joint costs allocated, 0.40; 0.60 × $600,000 | $240,000 | $360,000 | $600,000 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Floor Mats** | **Car Mats** | **Rubber Shreds** | **Total** |
| Revenues, 25,000 × $12;  85,000 × $6 | $300,000 | $510,000 | $30,100d | $840,100 |
| Cost of goods sold: |  |  |  |  |
| Joint costs allocated, 0.40;  0.60 × $600,000 | $240,000 | $360,000 |  | $600,000 |
| Less: Ending inventory | ( 48,000)e | ( 33,600)f |  | ( 81,600) |
| Cost of goods sold | $192,000 | $326,400 |  | $518,400 |
| Gross margin | $108,000 | $183,600 | $30,100 | $321,700 |

d 43,000 lbs × $0.70 per lb. = $30,100

e 6,250 × $240,000/31,250 = $48,000

f 8,750 × $360,000/93,750 = $33,600

1. The production method of accounting for the byproduct is only appropriate if The Mat Place is positive they can sell the byproduct at the expected selling price. Moreover, The Mat Place should view the byproduct’s contribution to the firm as material enough to find it worthwhile to record and track any inventory that may arise. The sales method is appropriate if either the disposition of the byproduct is unsure or the selling price is unknown, or if the amounts involved are so negligible as to make it economically infeasible for The Mat Place to keep track of byproduct inventories.

**16-34** (15 min.) **Byproduct-costing journal entries (continuation of 16-33).**

1. Byproduct—production method journal entries

i) At time of production:

Work-in-process Inventory 600,000

Accounts Payable, etc. 600,000

For Byproduct:

Finished Goods Inv – Shreds 35,000

Work-in-process Inventory 35,000

For Joint Products

Finished Goods Inv – Floor 226,000

Finished Goods Inv – Car 339,000

Work-in-process Inventory 565,000

ii) At time of sale:

For Byproduct

Cash or A/R 30,100

Finished Goods Inv – Shreds 30,100

For Joint Products

Cash or A/R 810,000

Sales Revenue – Floor 300,000

Sales Revenue – Car 510,000

Cost of goods sold – Floor 180,800

Cost of goods sold – Car 307,360

Finished Goods Inv – Floor 180,800

Finished Goods Inv – Car 307,360

2. Byproduct—sales method journal entries

i) At time of production:

Work-in-process Inventory 600,000

Accounts Payable, etc. 600,000

For byproduct:

No entry

For Joint Products

Finished Goods Inv – Floor 240,000

Finished Goods Inv – Car 360,000

Work-in-process Inventory 600,000

ii) At time of sale

For byproduct

Cash or A/R 30,100

Sales Revenue – Shreds 30,100

For Joint Products

Cash or A/R 810,000

Sales Revenue – Floor 300,000

Sales Revenue – Car 510,000

Cost of goods sold – Floor 192,000

Cost of goods sold – Car 326,400

Finished Goods Inv – Floor 192,000

Finished Goods Inv – Car 326,400

**16-35** (40 min.) **Process further or sell, byproduct.**

1. The analysis shown below indicates that it would be more profitable for Newcastle Mining Company to continue to sell bulk raw coal without further processing. This analysis ignores any value related to coal fines. It also assumes that the costs of loading and shipping the bulk raw coal on river barges will be the same whether Newcastle sells the bulk raw coal directly or processes it further.

|  |  |
| --- | --- |
| Incremental sales revenues: |  |
| Sales revenue after further processing (8,460,000a tons × $34) | $287,640,000 |
| Sales revenue from bulk raw coal (9,000,000 tons × $30) | 270,000,000 |
| Incremental sales revenue | 17,640,000 |
|  |  |
| Incremental costs: |  |
| Direct labor | 790,000 |
| Supervisory personnel | 190,000 |
| Heavy equipment costs ($35,000 × 12 months) | 420,000 |
| Sizing and cleaning (9,000,000 tons × $3.30) | 29,700,000 |
| Outbound rail freight (8,460,000 tons ÷ 600 tons) × $250 per car | 3,525,000 |
| Incremental costs | 34,625,000 |
| Incremental gain (loss) | $ (16,985,000) |

a 9,000,000 tons × (1– 0.06)

1. The cost of producing the raw coal is irrelevant to the decision to process further or not. As we see from requirement 1, the cost of producing raw coal does not enter any of the calculations related to either the incremental revenues or the incremental costs of *further* processing. The answer would the same as in requirement 1: Do not process further.
2. The potential revenue from the coal fines byproduct would result in additional revenue ranging between $5,670,000 (at a market price of $14) and $10,125,000 (at a market price of $25).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Coal fines | = | 75% of 6% of raw bulk tonnage | | | |
|  |  | = | 0.75 × (9,000,000 × 0.06) | | | |
|  |  | = | 405,000 tons | | | |
|  |  |  |  | | | |
|  | Potential incremental income from preparing and selling the coal fines: | | | | | |
|  |  | | | Minimum |  | Maximum |
|  | Incremental income per ton  (Market price – Incremental costs) | | | $9 ($14 – $5) |  | $22 ($25 – $3) |
|  | Incremental income ($9; $22 × 405,000) | | | $3,645,000 |  | $8,910,000 |

The incremental loss from sizing and cleaning the raw coal is $16,985,000 as calculated in requirement 1. Analysis indicates that relative to selling bulk raw coal, the effect of further processing and selling coal fines is not beneficial at either minimum or maximum incremental income levels. Hence, further processing is still not in Newcastle’s interest. In fact, dividing the loss of $48,710,000 by the coal fines output of 405,000 tons reveals that the selling price of coal fines would have to increase to create an incremental income of at least $41.94 per ton for further processing to become Newcastle’s preferred option.

Note that other than the financial implications, some factors that should be considered in evaluating a sell-or-process-further decision include the following:

* Stability of the current customer market for raw coal and how it compares to the market for sized and cleaned coal
* Storage space needed for the coal fines until they are sold and the handling costs of coal fines
* Reliability of cost (e.g., rail freight rates) and revenue estimates and the risk of depending on these estimates
* Timing of the revenue stream from coal fines and impact on the need for liquidity
* Possible environmental problems, i.e., dumping of waste and smoke from unprocessed coal

**16-36** (30 min.) **Joint-cost allocation, process further or sell.**

###### Joint costs

$10,800,000

1. Separable Costs

###### Apple

###### Further

###### Processing

$8,400,000

###### Celeronmm

###### Processing

###### Broadcomom

#### Splitoff

point

**Apple Broadcom Celeron Total**

Final sales value of total productiona $3,570,000 $3,960,000 $15,000,000 $22,530,000

Deduct separable costs — \_\_\_\_\_ — 8,400,000 8,400,000

Net realizable value at splitoff point $3,570,000 $3,960,000 $ 6,600,000 $14,130,000

Weightingb 0.253 0.280 0.467 1.000

Joint costs allocatedc $2,732,400 $3,024,000 $5,043,600 $10,800,000

a $7 × 510,000; $4 × 990,000; $10 × 1,500,000

b $3,570,000; $3,960,000; $6,600,000 ÷ $14,130,000

c $10,800,000 × 0.253; $10,800,000 × 0.280; $10,800,000 × 0.467

2.

Further processing Apple

#### Incremental revenue

($11.00 × 455,000) – ($7.00 × 510,000) $ 1,435,000

Incremental processing cost 1,500,000

Incremental operating income/(loss) $ (65,000)

Further processing Broadcom

#### Incremental revenue

($5.00 × (990,000 × 1.25)) – ($4 × 990,000) $2,227,500

Incremental processing cost 2,000,000

Incremental operating income $ 227,500

Further processing Celeron

Incremental revenue

($10.00 × 1,500,000) – ($4.75 × 1,500,000) $7,875,000

Incremental processing cost 8,400,000

Incremental operating income/(loss) $ (525,000)

### Current Policy

#### NRV (from requirement 1):

#### Sell Apple at splitoff $3,570,000

Sell Broadcom at splitoff 3,960,000

Process Celeron further 6,600,000

14,130,000

Joint costs 10,800,000

Operating income $ 3,330,000

### Preferred Options

Sell Apple at splitoff $3,570,000

Process Broadcom further

($3,960,000 + $227,500 incremental optg. inc.) 4,187,500

Sell Celeron at splitoff

($6,600,000 + $525,000 incremental optg. inc.) 7,125,000

14,882,500

Joint costs 10,800,000

Operating income $ 4,082,500

Iridium is $752,500 better off by changing two of its current policies—it should process Broadcom further ($227,500 improvement) and sell Celeron at splitoff ($525,000 improvement).

**16-37** (60 min.) **Methods of joint-cost allocation, comprehensive.**

1. Joint costs for Kardash include $440,000 in direct materials, $220,000 in direct labor, and $110,000 in overhead costs, for a total of $770,000.

2. At splitoff, the relative weights of the two perfumes are 7,000 ounces of Seduction and 49,000 ounces of Romance (in the form of residue) respectively. Accordingly, the allocation of joint costs under the physical measure method would be in the ratio of 1:7, or as follows:

Seduction:  = $96,250

Romance:  = $673,750.

3. The relative sales values of production at splitoff are as follows:

Seduction: 7,000 × $56 per ounce = $ 392,000

Romance: 49,000 × $24 per ounce = $1,176,000

The ratio of the sales values is 392:1176, or 1:3. Accordingly, the joint costs are allocated as:

Seduction:  = $192,500

Romance:  = $577,500.

4. Estimated net realizable value per ounce of Seduction perfume:

Selling price per unit: $109.50

(–) Unit packaging cost: $137,500/5,000 = 27.50

Estimated NRV per ounce: $ 82.00

Estimated net realizable value per ounce of Romance perfume:

Selling price per unit: $31.50

(–) Unit packaging cost: $196,000/28,000 = 7.00

(–) Unit processing cost in B: $112,000/28,000 = 4.00

Estimated NRV per ounce: $20.50

5. The estimated net realizable values of the two perfumes are as follows:

Seduction: 7,000 × $82 per ounce = $ 574,000

Romance: 49,000 × $20.50 per ounce = $1,004,500

The ratio of the ENRVs is 574,000:1,004,500, or 4:7. Accordingly, the joint costs are allocated as:

Seduction:  = $280,000

Romance:  = $490,000.

6. The gross margin for Kardash Cosmetics as a whole is the sum of the expected net realizable values from Seduction and Perfume, less the joint costs incurred. From the calculations in requirement 5, this is given by:

ENRV of Seduction ($574,000) + ENRV of Romance ($1,004,500) – Joint Costs ($770,000)

= $808,500.

The final sales value of the total production is:

Seduction (7,000 × $109.50) + Romance (49,000 × $31.50) = $2,310,000.

The gross margin percentage for the firm as a whole is therefore:

 = 35%.

7. The joint cost allocations to Seduction and Romance under the constant gross-margin percentage NRV method are given as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Seduction** | **Romance** | **Total** |
| Final sales value of production |  |  |  |
| 7,000 × $109.50; 49,000 × $31.50 | $766,500 | $1,543,500 | $2,310,000 |
| Gross Margin (35%) | 268,275 | 540,225 | 808,500 |
| Total costs | $498,225 | $1,003,275 | $1,501,500 |
| Separable costs  7,000 × $27.50; 49,000 × $11 | 192,500 | 539,000 | 731,500 |
| Joint costs | $305,725 | $464,275 | $ 770,000 |
|  |  |  |  |
|  |  |  |  |

8. No. Selling the residue earns Kardash $24 per ounce. Selling Romance perfume yields (from the calculations in requirement 4) $20.50 per ounce, which is lower. The manager of Kardash Cosmetics could earn an extra $3.50 per ounce by selling residue rather than Romance.