

Summary

This study has three major objectives. The first is to explain the present location pattern of the synthetic-fiber industry in the United States. The second is to forecast the regional distribution of the industry's future growth in terms of both direct employment and capital investment. The third is to evaluate the advantages of Puerto Rico, a low labor-cost area, as a location for synthetic-fiber production.

Synthetic Fibers

The term "synthetic fibers" is defined to include only fibers which are manufactured from synthetic polymers. Representative of such fibers are nylon, Orlon, Acrilan, dynel, and Dacron. These fibers are closely associated with that spectacularly growing sector of the organic chemical industry involving the synthesis of useful materials from basic hydrocarbons. The promise of these fibers, together with the significant effects their production has already wrought in the textile field, justifies a study of their future influence on regional development.

Feasible Locations

In the United States potentially feasible locations for the complex of productive processes leading to synthetic fibers are effectively limited to two sets of regions. One set—the Texas-Gulf Coast area and the West Virginia area—contains sources of the basic hydrocarbon and other chemical raw materials. The second set—*New England*, the *Middle Atlantic* region, the *East South* region (Virginia, North Carolina, and South Carolina), the *Central South*

region (Georgia and the eastern parts of Alabama, Tennessee, and Kentucky), and the *West South* region (Mississippi, Louisiana and the western parts of Alabama, Tennessee, and Kentucky)—comprises the markets for synthetic fibers, i.e., the textile manufacturing areas. In addition, Puerto Rico is considered as a synthetic-fiber production location. Puerto Rico cannot be characterized as either a raw-material or a market region, although it is possible that at least some of the basic hydrocarbon raw materials could be supplied by oil refineries on the island. However, Puerto Rico is a low labor-cost area and thereby furnishes an alternative to the location of synthetic-fiber production on the mainland.

The Texas-Gulf Coast region contains a dominant proportion of the continental United States' reserves of crude petroleum and natural gas. The selection of this region reflects the fact that petrochemical materials and processes form the basis for a major part of the chemical-intermediate production required in the synthetic-fiber industry. On the other hand, the West Virginia sector of the Middle Atlantic region possesses a highly developed chemical industry which could furnish some of the required chemical intermediates, produced at least in part from local raw materials. For that reason the West Virginia area is considered as the second principal raw-material region.

The technology of the synthetic-fiber industry comprises two distinct major stages: (a) production of chemical intermediates, (b) transformation of the intermediates into fibers. Therefore, the location analysis logically considers the following sets of alternatives:

1. Texas-Gulf vs. West Virginia as the *source of raw materials* for chemical-intermediate production.
2. Raw material vs. market regions and Puerto Rico as locations for *chemical-intermediate production*.
3. Raw material vs. market regions as locations for *synthetic-fiber production*.
4. Puerto Rico vs. mainland sites as locations for *synthetic-fiber production*.

Regional Cost Differences

Regional advantage in the production of synthetic fibers is basically dependent upon regional differences in costs of production, including transport costs. Thus the analysis need consider only the elements of cost which exhibit significant regional variation. Those elements which exhibit no pattern of systematic regional variation may be ignored. So may those elements which

constitute such a small share of total cost that they lead to insignificant regional differences.

For plants of equal size, in either the chemical-intermediate stage or the synthetic-fiber stage, regional equality may be assumed for capital costs and fixed charges, e.g., plant construction costs, interest charges, depreciation, plant maintenance, insurance, taxes, and land costs. These items are ignored in estimating regional advantage and disadvantage.

Other important costs, however, do exhibit regional differences. For chemical intermediate production these costs cover outlays for (a) major raw-material inputs, (b) utilities, and (c) direct labor. For synthetic-fiber production they cover outlays for (a) major chemical intermediates and solvents, (b) utilities, and (c) direct labor.

Differences in size of plants feasible at different locations can result in significant cost differences. This possibility for regional advantage or disadvantage exists and is evaluated for the production of chemical intermediates. In the synthetic-fiber stage, however, plants of technologically optimum size could be built in any of the regions considered. Thus in the latter stage no regional cost differences arise because of differences in plant size.

Findings of the Study

Chemical Intermediate Production

With respect to the location of chemical-intermediate production, the findings of the study indicate in general that costs are minimized at sites in raw-material regions. It is estimated that 70 to 87.5 per cent of the new chemical intermediate capacity required by the expansion of synthetic-fiber production by 1975 will be located in the Texas-Gulf Coast area. The other 12.5 to 30 per cent can be expected in the West Virginia raw-material region and nearby areas. The above statements hold except for nylon-salt plants. Nylon salt can be produced economically either in multi-product chemical plants in raw-material regions or in fully integrated nylon operations in the textile area. It is therefore estimated that 50 per cent of new nylon-salt capacity required by 1975 will be in the Texas-Gulf Coast region, 10 per cent in West Virginia and neighboring states, and 40 per cent in the textile South.

Puerto Rico is subject to general disadvantage in the manufacture of chemical intermediates for synthetic fibers. However, from bagasse the island could produce furfural, one of the possible basic raw materials for nylon salt.

Synthetic-Fiber Production

On the mainland costs of synthetic-fiber output tend to be minimized at locations in the fiber-market regions which comprise the textile area. However, location in the West Virginia area is almost as favorable. Furthermore, Puerto Rico exhibits the lowest total costs of all the sites considered for synthetic-fiber production. Accordingly, it is estimated that of the total new synthetic-fiber capacity erected by 1975 80 per cent will be in the textile South and Puerto Rico and 20 per cent in the West Virginia area.

Direct Employment and Capital Investment

For the synthetic fibers examined capacity required by 1975 is estimated at 710 to 830 million annual pounds. The new investment required for plant and facilities is set at \$1.1 to \$1.3 billion. Direct and indirect labor requirements of these new synthetic fiber plants will provide an estimated 30,650 to 36,225 new jobs. Total new capacity for the required chemical intermediates is estimated at 649 to 783 million annual pounds. The corresponding investment in plant and equipment is set at \$238 to \$294 million. The direct labor requirements for this additional chemical-intermediate production will provide 950 to 1150 new jobs.

On the basis of these totals and the stated percentage distribution by regions, new investment in chemical-intermediate facilities for the Texas-Gulf Coast region is estimated at \$155 to \$190 million; the new employment, 630 to 750 jobs. The new investment estimated for West Virginia and nearby areas is \$35 to \$40 million in chemical intermediate plants and \$220 to \$265 million in fiber plants. Total new employment for this area is estimated at 6280 to 7420 jobs. New investment in chemical intermediate facilities in the textile South (other than Virginia) is estimated at \$50 to \$63 million; new employment at 160 to 180 jobs. This region and Puerto Rico will share an estimated new investment in synthetic-fiber plants of \$875 million to \$1.1 billion and new employment of 24,525 to 28,980 jobs.

There is no firm objective basis for making a separate estimate of the extent to which Puerto Rico will share in the development of synthetic fibers. It can be noted, however, that one typical 60-million-pound-per-year, continuous-filament fiber plant would call for an investment of \$150 million and create over 4000 jobs. A staple fiber plant of the same capacity would require an investment of \$75 million and would create 1000 jobs.