

# Technologies of primary conversion, fractioning and purification of pruning products, thinnings and coppice forests of cork oaks

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## I - Introduction

From the model of Cork oak culture representative in Portugal - cork forest, cork oak forest and coppice forest - produces remains of pruning and strips of branches and materials of small and medium dimensions of relevant importance to the research economy. But such diversity and heterogeneous nature, makes very complex and skillful its qualificative technological processing. On the other hand, the cork culture is one of the forestry portuguese specificities, with big inner incidence; from which the importance of the rational and integral evaluation of all its resources.

The settlement of the problems which are placed in this context, of reduced dimensions materials, is tightly linked to the success of operations of primary conversion, fractioning and purification of the components, although with different levels of difficulties for the effective provenances.

But, in agroforestry or sylvopastoral systems (cork forest) which cover about 600 thousand hectares, a quali-

fied cultural conducting in terms of reproduction cork, and sustained in terms of production, requires the realization of reproduction prunnings, whose average quantitative of remains is evaluated at 0,5 ton/ha/year, what is equivalent, in defined area, to 325 thousand tons a year of green fuelwoods. The pruning constitutes an indisputable operation in this artificialised cork culture model ; but in terms of research economy, a compensatory or minimum profit has to be found in order to get round its backwards.

It must be still said, that one of the forestry proposals in the field of the "PAC" will be in basic mediterranean marked areas influence, the exploration in coppice forest and high forest (cork oak forest).

## II - Nature of the materials

Fundamentally, all the materials here considered present a common characteristic. They are impure, with three components : virgine cork; innerbark; and wood. But they define themselves by : different opportunities of crop in terms of vegetative activity of the

plant (remains of the prunings, in Winter; cuts of coppice forest and thinning, in Summer), or distinct periods of meristematic intensity (phellogen and cambium). This leads to different degrees of difficulty in the processes of fractioning and purification of the components, indubitably major in the case of the remains of the prunings.

It also happens, that the relative value of the fractions is very dissimilar. In the first place, appears the virgin cork which, with enough purity, has the highest one for granulated and decorative corkboards (while by the classical processing it is only used in insulation corkboards); in second place, the wood fraction more or less impure, traditionally consumed for energetic purposes (fuelwoods and charcoal); in the third place, the innerbark, sensitive to the tannins extraction. The modest value of the pruning remains fundamentally results of their impurity, by difficulties of a satisfactory fractioning.

The products of the coppice forests and thinnings, are obtained in summer cuts, allowing the first stripping to obtain virgin pure corks, even round wood, eventually with small fractions of innerbark, also in the major part pure.

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### III - Fractional proportion

In middle course and in opportune prunings, the proportions, in green weight, of the remains components are: wood - 65%; cork - 18%; innerbark - 17%; but the theoretical national possibility is as follows : wood - 290 thousand tons; cork - 80 thousand tons; and innerbark - 75 thousand tons. As the moisture content in each fraction are of 80% in the wood, 15% in the cork and 90% in the innerbark, the mass values in dry condition are respectively, 160 thousand tons, 70 thousand tons of cork and 40 thousand tons of innerbark. We have to consider the origin of materials, because the area of coppice forest being very limited and the volume of the thinnings not being reasonably sizeable enough, due to the lack of cork forest management and the sanitary crisis of the cork forest. In normal conditions, the supply of coppice forest and thinning is less significant.

### IV - Conventional technologies of conversion

Traditionally, the remains of the prunings are submitted to stripping the outer cork manually, with axe, it results two impure fractions: the cork portion (*falca* = virgin cork + innerbark) and wooden portion (wood + innerbark). The proportion of the innerbark in one and other fraction results above all of the opportunity of the pruning and of the special way to strip the outer cork. In a certain way, the purity increases in the woody fraction, in the late pruning, inadvisable in biological and quality terms of the corkbark. Because this special way to strip the outer cork isn't opportune, it happens that all the fractions resultant are impure, and each time more expensive the extraction is by increasing cost of labor, what will quickly determine, its impracticability. It ensues from this the pertinence of the

realization/mechanization of the processing to reach the two fundamental objectives : possibility of execution of prunings and optimization of the benefits of the resources.

In Portugal, during many years, people assumed a sceptic attitude in this matter. And, when it was approached progressively the machanization, it has been tried to mechanize the primary conversion, but they didn't care about the fractioning and the purification, from where only being proposed consecrated to the innerbark + cork (*falca*) and to the wood, taking no care of increasing values. Only in 1976 was expressed a global perspective of the problem (Carvalho, 1976).

Meanwhile, an irrelevant discussion was promoted about benefits /damages of pruning, not including into the real context the exceeded artificialization of the culture like the cork forest culture. However, the success of the mechanical conversion in similar materials in the other countries, arose consciencies, not being representative the situations, by respecting the coppice forests and thinnings and not the prunings.

### V - Development in primary conversion of the remains

The capricious morphology of the remains of the prunings and their reduced dimension, the opportunity of the obtaining (period of dormancy) and the biodegradative sensibility of the woody fraction (fungus) and liber fraction (insects), pose problems of complex solution.

The primary conversion developed two methodologies : chipping and barking. After that, two types of products have been obtained : woodchips, nearly pure, and mixed chips of innerbark and cork (*falca*). The processing has to include subsequent fractioning, by methods that appeal to the densimetry and/or hygroscopicity, but the most valuable component (cork) persits

impure. However, the fragility of the innerbark enables the purification, by grinding and screening. Considerable improvements are possible by frontal chippers 90-90 (drum chipper), once that the innerbark fraction is circumscribed to a narrow band of 3-4mm wide (thickness of the chips).

Other way, faces the peeling woods after the roundwood short in straight segments, leads to the simplification of the feeding of the machines and a more perfect attack of the tools. However, to diminish the strong cohesion among the several components, we proceed to the preparatory hydrothermic treatment what will provoke interfacial cleavages, by distinct behaviour of the cork and of the wood to the boiling(1). Specific equipment allows to detail the *falca* at the way out channels distinct of the two components : roundwood short and *falca* particles. However, also in this behaviour the conclusive purification requires grinding and screening to separate the friable innerbark.

Summing up, the proposed technologies and the mechanic ways adapted or conceived allow, with satisfactory quality, to proceed to the primary conversion, fractioning and purification of the remains of the pruning of the corks tree and similar materials - of coppice forest and thinnings. The choice of the preparatory processing must think about technical aspects (machines and tools), energetic costs and water, pollution, as well as quality and presentation of the fundamental fractions, cork and wood, in terms of purity and perspective of technological profit. The schematisation of the two processings makes easy the comparative analysis (See Fig. 1).

(1) - The virgin cork has significant expansion in all the direction, specially in radial, when submitted to the hydrothermic treatment, what eases the separation of the liber and cork tissues of the underlying wood, and the consequent detachment of the *falca* in plates.

Fundamental direction	Total expansion (%)
tangential	4
axial	4
radial	15

## VI - Conclusions

The increase of the value of woody-cellulosical secondary heterogeneous materials, of forests of long revolutions, assumes particular emphasis in the mediterranean regions where, by conjunctural specific characters and by productive specificities, the harmonization sylvo-industrial is particularly delicate. The protective function which must assume the arboreal covering is contingent upon the production and requires specific technologies of maximization and optimization of the biomass profit. So that, the single secondary resources of the Cork Oak culture, justifies the presentation of this communication.

**A.C.**

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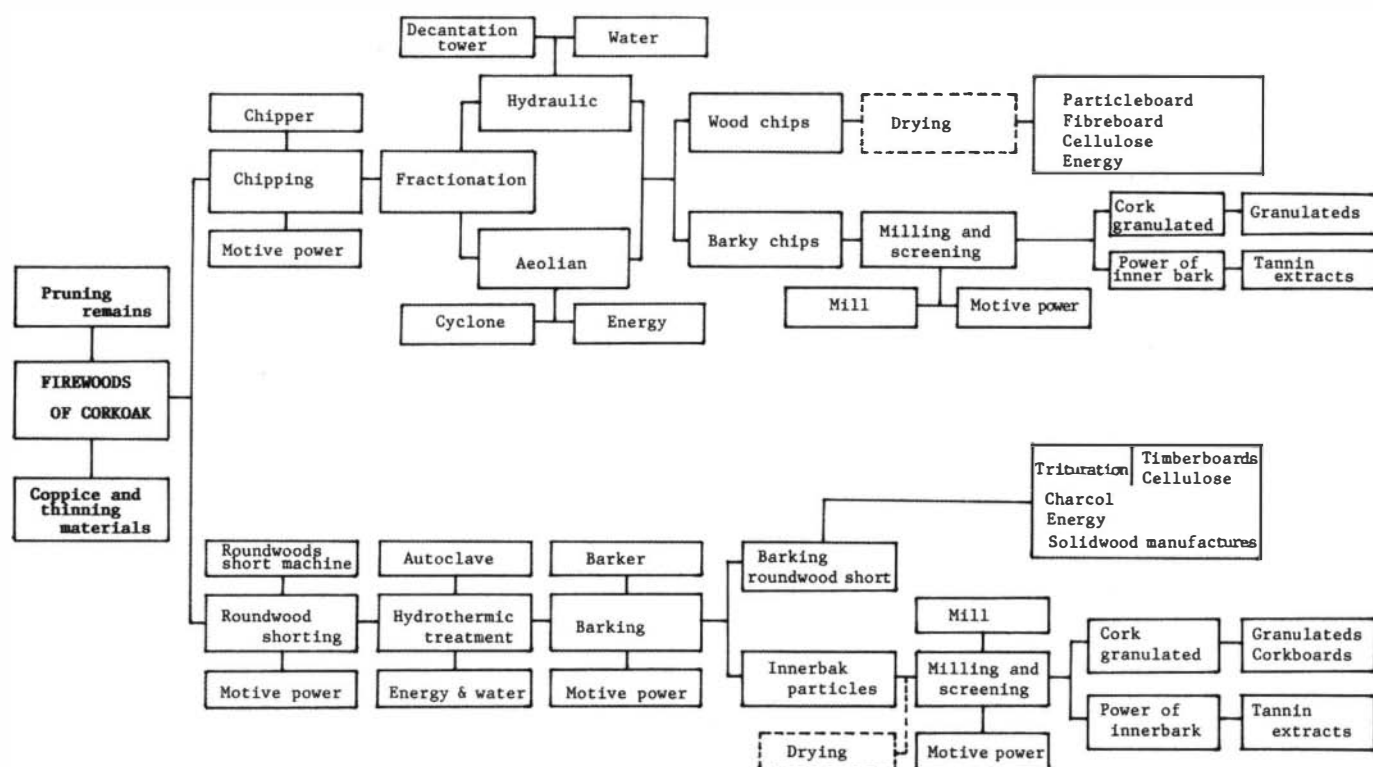


Fig. 1 : Technological processing of remains and coppice forest and thinnings materials

## Sumário

### **Tecnologias de conversão primária, fraccionamento e purificação de produtos de podas, desbastes e talhadas de sobreiro**

*Portugal é o maior país suberícola do Mundo. A cultura do Sobreiro faz-se artificialmente. Os sobreirais são uma forma original de exploração agro-florestal, especialmente pela poda.*

*Os despojos da poda têm servido para a fabricação de carvão e, também, para a fabricação de aglomerados negros com a falca (mistura de tecido suberoso e de liber, mesmo de lenho). Se as podas continuarem a ser necessárias, não será possível conservar um património tão importante senão pela racionalização da exploração dos despojos e pela sua máxima utilização tecnológica.*

*O mais simples processo de resolver o problema dos pequenos ramos é a conversão em estilha. Por outro lado, o descasque é praticamente impossível com o equipamento existente, mas viável após o tratamento hidro-térmico dos despojos, permitindo constituir dois grandes lotes: material lenhoso e material cortical (cortiça e entrecasco). O fraccionamento da porção cortical pode completarse por uma segunda operação em torres de decantação. E assim possível obter três fracções: lenhosa, suberosa e liberina, o que permite antever boas perspectivas tecnológicas: cortiça virgem - granulação e aglomeração (aglomerados negros); lenho - qualquer industria de trituração (aglomerados e celulose); entrecasco - extracção de taninos.*

## Résumé

### **Technologie de première transformation, fractionnement et purification des produits d'élague des chênes-liège**

*Le Portugal est le plus grand pays subéricole du monde. La culture du chêne-liège se fait artificiellement. Les suberaies sont une forme originale d'exploitation agro-forestière, spécialement par l'élague.*

*Les déchets de l'élague ont servi à fabriquer du charbon, et aussi des agglomérés noirs avec la falca (mélange de tissu subéreux et de liber, même de bois). Si les élagages continuent à être nécessaires, il ne sera pas possible de conserver un patrimoine aussi important que par la rationalisation de l'exploitation des déchets et par son maximum d'utilisation technologique.*

*L'une des façons les plus simples de résoudre le problème des menus branchages est leur conversion en plaquettes. D'autre part, l'écorçage est pratiquement impossible avec l'équipement disponible, mais possible grâce au traitement hydro-thermique des déchets, permettant de constituer deux grands lots : le matériel ligneux et le matériel cortical (liège et mère). Le fractionnement de la portion corticale étant complété par une seconde opération dans les tours de décantage. Il est donc ainsi possible d'obtenir trois fractions : ligneuse, subéreuse et liège-mère, ce qui permet d'entrevoir de bonnes perspectives technologiques : liège mâle -industries de granulation et agglomération (agglomérés noirs) ; bois -peut être appliqué dans n'importe quelle industrie de trituration (cellulose et agglomérés); liège mère -dans l'extraction du tanin.*

## Summary

### **The technology involved in the initial handling and subsequent particle production and treatment of cork oak "slash" and thinnings**

*Portugal is the world's foremost producer of cork. Cork oak forests here are the result of human intervention, particularly by lopping ; thus, the woodlands are an original form of agriforestry.*

*Slash has been used to make charcoal and also for the production of black particle board using falca (a mixture of corky material and phloem, and even wood). If upkeep involving pruning continues to be necessary, the only possible way to preserve traditional practices will be by rationalising the use of waste wood by maximising its utilisation through appropriate technology.*

*One of the easiest methods of dealing with the lighter clippings and prunings is to convert them into small plaques. A first point : it is wellnigh impossible to mechanically strip the cork with the equipment presently available. On the other hand, when the cuttings are subjected to a hydro-thermal treatment, two separate types of product result : woody material (xylem) as distinct from the cork bark and cambium layer. This second batch of outer sapwood and bark undergoes a further separation process in decanting tanks. Thus, three types of material separate out : cork bark, suitable for industrial use in particle form (black chip board) ; wood, usable in any pulping or particle activity (cellulose or panel boards) ; the first bark from which tannin can be extracted.*