



Acti-Zyme in Paris

***PREFECTURE DE LA SEINE – DEPARTMENT OF SANITATION
TREATMENT OF A PRIMARY DIGESTER OF 5000 m³ WITH THE
BOIOLOGICAL COMPOUND **ACTI-ZYME** MADE IN
ACHERES (FRANCE) TREATMENT PLANT IN PARIS.***

1. AIM OF THE TREATMENT

THIS BIOLOGICAL TREATMENT IS MADE IN ORDER TO OBTAIN THE FOLLOWING RESULTS:

- 1-1 **THICKENING OF THE SLUDGES** THROUGH A HIGHER MINERALIZATION WHICH, BY RAISING THE DENSITY, CAUSES A CONCENTRATION OF DRY ELEMENTS IN THE LOWER PART OF THE DIGESTER.
- 1-2 **REDUCTION IN VOLUME OF THE EXTRACTIONS.** CONSEQUENTLY, A REDUCTION IN VOLUME OF THE SLUDGES TO BE EXTRACTED IS OBTAINED. THIS DECREASE IS COMPENSATED BY A RAISE IN VOLUME OF THE SUPERNATANT WHICH LOOKS LIKE A LIQUID WITH A LIGHT AMBER COLOURING. IT IS EXTRACTED FROM THE CENTRAL PART OF THE DIGESTER ACCORDING TO ITS HEIGHT. THIS LIQUID IS MAINLY COMPOSED OF VITAL ACIDS IN EXCESS. (SEE 3.5.). IN THE CASE OF THIS **ACTI-ZYME** TREATMENT, THIS SUPERNATANT **FORMS AN EXCELLENT FLOCCULATION AGENT IN THE PRIMARY AND SECONDARY CLARIFIERS.**
- 1-3 **IMPROVEMENT IN QUALITY OF SLUDGES.** SLUDGES DIGESTED WITH THE **ACTI-ZYME** TREATMENT HAVE DEWATERING QUALITIES VERY NOTABLY INCREASED THROUGH A REDUCTION IN SUPERFICIAL TENSION OF THEIR PARTICLES. **THIS PARTICULARITY ALLOWS A REDUCTION IN THE USE OF COAGULANTS;** VERY APPRECIABLE ON THE ECONOMIC LEVEL.

- 1-4 INCREASE IN QUANTITY AND QUALITY OF THE GAS PRODUCED BY THE DIGESTION. THE DESTRUCTION AND HYDROLISISOF A HIGHER QUANTITY OF VOLATILE SUBSTANCES AND NOTABLY OF CELLULOSES THROUGH THE **ACTI-ZYME** COMPOUND CAUSES A RISE IN THE PRODUCTION OF GAS WHICH CONTRIBUTES TO OBTAIN A LARGER ENERGETIC AUTONOMY OF THE PLANT. THE PRODUCT HAS GENERALLY AN ACTION ON THE QUALITY OF THIS GAS BY REDUCTION IN THE PROPORTION OF CARBON DIOXYDE AND A RISE IN THE PROPORTION OF METHANE.
- 1-5 RAISE IN BUFFER CAPACITY. THE TREATMENT BRINGS ALSO AS CONSEQUENCE AN IMPORTANT RISE IN THE BUFFER CAPACITY OF THE DIGESTER WHICH IS RECORDED BY MEASUREMENT OF THE TOTAL ALKALINITY. THIS ABILITY BRINGS A HIGHER SECURITY IN THE RUNNING OF THE DIGESTER.
- 1-6 USE OF DIGESTED SLUDGES AS NATURAL FERTILIZER. IF SLUDGES ARE USED AS NATURAL ORGANIC FERTILIZER, THE RICHNESS OF ITS COMPOUNDS CAN BE INFLUENCED STOPPING THE DIGESTION AT A LEVEL PREDETERMINED THROUGH ANALYSES (SEE 6.6)
- 1-7 VANISHING OF ODORS. THE AESTHETIC AND OLFACTIVE CONSEQUENCE OF TREATMENT IS THE DISAPPEARING OF ILL SMELLING ODORS AROUND THE DIGESTER. THE EXTRACTED DIGESTED SLUDGES SPREAD ON THE DRYING BEDS LOSE THEIR ODOR IN A QUARTER OF AN HOUR.

2. APPLICATION OF THE TREATMENT

THE TREATMENT IS USED IN SUCCESSIVE QUANTITIES FOR A PERIOD DETERMINED BY A SCHEDULE TO OBTAIN A TOTAL AMOUNT OF 33 mg/l IN THE CASE OF URBAN SLUDGES OR 33 g per m³.

THIS TIMING OF THE TREATMENT MAKES IT POSSIBLE TO OBTAIN A PROGRESSIVE ACCLIMATATION AND ADAPTION OF THE BACTERIAL POPULATIONS IN THE MIDDLE WHERE IT IS USED.

3. RESULTS OF THE TREATMENT

BIOLOGICALLY, THE MAIN RESULTS OF THE **ACTI-ZYME** TREATMENT ARE:

- 3-1 THE DEVELOPMENT OF A CONTROLLED ANAEROBIC DIGESTION LEAVING BY EXAMPLE NO POSSIBILITY FOR THE CREATION OF DEVIATED FERMENTATION BY SULPHUR-REDUCING BACTERIA PRODUCING SULPHUR DIOXYDE (SO₂), HYDROGEN SULPHIDE (H₂S) OR MERCAPTAN.

ACTI-ZYME BACTERIA REPLACE PROGRESSIVELY THE POPULATIONS WHICH WERE PREVIOUSLY IN THE MASS OF THE DIGESTER. INDEPENDENTLY OF ANALYSES TO INDICATE THE QUALITY OF THE GAS, A VISUAL CONTROL OF THIS QUALITY AND OF THE ABSENCE OF TOXIC COMPOUNDS COULD BE CHECKED THROUGH THE COLOR OF THE BURNER'S FLAME WHICH WILL LOSE ITS ORANGE YELLOW COLOURING TO BECOME PALE BLUE.

- 3-2 THE NATURAL BIOLOGICAL MIXING WHICH REPLACES MIXING BY MECHANICAL MEANS OR BY DIGESTION GAS. BY DENSITY DIFFERENCE, FRESH SLUDGES OR SLUDGES OF A PRIMARY DIGESTER, INTRODUCED DAILY, COME IN CONTACT WITH THE MAIN BIOLOGICAL MASS ACCUMULATED ON THE DIGESTER'S BOTTOM. THEIR VOLATILE MATERIALS ARE VERY QUICKLY TRANSFORMED IN GAS BUBBLES WHICH ACCUMULATE IN FORM OF DOMES IN THE MASS OF THE SLUDGES AND EVEN ON THE FLOOR OF THE DIGESTER. WHEN THE VOLUME OF THE DOMES BECOMES SUFFICIENT TO COMPENSATE THE SURROUNDING PRESSURE, A RISING TO THE SURFACE TAKES PLACE WITH A VERY LARGE ASCENCIONAL SPEED WHICH CARRIES UP A HUGE QUANTITY OF SLUDGES FROM THE BOTTOM.

THE BUBBLE BURSTS ON THE SURFACE AND RELEASES THE "SEEDED SLUDGES" WHICH HAVE A DOUBLE ACTION:

- GOING DOWN AGAIN AND CARRYING TO THE BOTTOM THE MATERIALS IN SUSPENSION IN FRESH SLUDGES.

- SEEDING THESE SAME MATERIALS FOR DISINTEGRATION ON THE BOTTOM OF THE DIGESTER.

THE ALTERNATION OF MOVEMENTS IS CONTROLLED BY THE DIFFERENCES OF ACCUMULATED PRESSURES ACCORDING TO THE GAS PRODUCTION.

THIS VERY STRONG PERMANENT NATURAL MIXING EQUALLY DISTRIBUTED IN THE WHOLE VOLUME OF THE DIGESTER PREVENTS THE BUILDING OF A FLOATING MAT ON THE SURFACE OF THE DIGESTER.

MEASUREMENTS TAKEN ON NON-HEATED, NON-MIXED OPEN-AIR DIGESTERS HAVE SHOWN THAT THE VOLUME OF SLUDGES CARRIED TO THE SURFACE REACHED ONE THIRD OF THE LAYER ACCUMULATED ON THE BOTTOM AND THAT THE REMAINING TWO THIRDS WERE PERMANENTLY MIXED BY THE FORMING BULBS WITHOUT EVER ALLOWING SOLIDIFICATION OR MASS THICKENING.

- 3-3 THICKENING OF THE SLUDGES THROUGH ACTIVATION OF THE DIGESTION. SLUDGES HAVE A TENDENCY TO GET HEAVIER OWING TO A LARGER CONCENTRATION OF MINERAL MATERIALS IN THEIR DRY MATERIALS, THE BEST DIGESTION SLUDGES GO DOWN BY GRAVITY IN THE LOWEST PARTS OF THE DIGESTER'S CONE FROM WHICH THEY ARE EXTRACTED. ITS RESULT IS AN APPRECIABLE DECREASE OF THEIR VOLUME AND PROPORTIONAL INCREASE OF THE DIGESTION CAPACITY OF THE SYSTEM WHICH IS CONFIRMED AS INDICATED IN PARAGRAPH 4 "MANAGEMENT OF THE DIGESTER" BY TESTS FREQUENT EXTRACTIONS.
- 3-4 INCREASE OF THE PRODUCTION AND OF THE QUALITY OF GAS THE INCREASE IN VOLUME OF THE GAS PRODUCED IS DUE AS ABOVE MENTIONED TO THE ATTACK AND TO THE DEGRADATION OF A HIGHER PROPORTION OF ORGANIC MATERIALS AND ESPECIALLY OF CELLULOSES BUT ALSO TO THE FACT THAT THE METHANE BACTERIA MOBILIZE FOR THEIR VITAL NEEDS ALL THE AVAILABLE DEGRADABLE HYDROGEN AND CARBON COMPOUNDS.

- 3-5 INTERNAL PHYSICAL EFFECTS IN THE DIGESTER CONTRARILY TO A DIGESTER MIXED BY MECHANICAL MEANS OR THROUGH INJECTION OF THE DIGESTING GAS, THE VOLUME OF A DIGESTER TREATED WITH **ACTI-ZYME** IS NOT HOMOGENEOUS. A LIQUID STRATIFICATION IS PRODUCED WHICH EXISTS FROM THE BOTTOM TO THE SURFACE.
- 3.5.1 THE LAYER OF SLUDGES IN THE PROCESS OF DIGESTION WHICH ITSELF DECOMPOSES IN SEVERAL STRATA, THE MOST DEGRADED SLUDGES IN THE CONE AND ON THE BED, THE MOST RECENT SLUDGES IN THE HIGHER LEVELS, THIS WHOLE VOLUME CONSTITUTES "THE BIOLOGICAL RESERVE" OF THE DIGESTER WHERE THERE IS THE MOST ACTIVE PART IN WHICH THE BACTERIA POPULATIONS ARE CONCENTRATED. THE INTRA AND EXTRA CELLULAR EXCHANGES ARE PROMOTED THERE BE THE PRESSURE (INTENSIFICATION OF THE OSMOSE PRESSURE).
- 3.5.2 THE SUPERNATANT WHICH IS A LIGHT AMBER COLOURED LIQUID MAINLY COMPOSED OF "VITAL" ACIDS WHICH HAVE NOTHING IN COMMON WITH VOLATILE ACIDS OF THE ACIDIFYING PHASE OF THE ANAEROBIC DIGESTION. THEY ARE THE WASTES PRODUCED BY THE BACTERIA DURING THEIR "DIGESTION" OF ORGANIC MATERIALS. THIS SUPERNATANT, LIKE ANY WASTE IN A LIVING BODY, MUST BE REGULARLY REMOVED OUT OF THE SYSTEM TO FACILITATE THE REACTION, OTHERWISE IT TURNS INTO AN INHIBITOR WHICH CAN MODERATE OR EVEN AT THE EXTREME, STOP THE ACTION OF THE BACTERIA.
- 3.5.3 THE UPPER PART OF THE DIGESTER IS AN EXCHANGE AREA COMPOSED OF BLACKISH WATER WHICH SERVES AS A VEHICLE FOR THE INTRODUCED FRESH SLUDGES AND FOR THEIR MIXING WITH THE SLUDGE COMING FROM THE BOTTOM. ON THEIR WAY THIS SLUDGE CROSSES THE SUPERNATANT AREA FROM WHICH THEY HAVE CARRIED ALONG A PART WHSICH WILL SERVE AS A FLOCCULANT AGENT TO THE PARTICLES OF FRESH OR PRIMARY SLUDGES WHICH WILL SINK EASILY. A NATURAL BALANCE IS CREATED BETWEEN THESE DIFFERENT LIQUID STAGES AS SOON AS

THE DIGESTER OBTAINS ITS REGULAR RYTHM, THAT MEANS AFTER 30 TO 45 DAYS. THE MAIN INTEREST OF THIS STRATIFICATION IS THAT A DECONTATION IS ALREADY OBTAINED IN THE DIGESTER ITSELF BE SEPARATION OF THE DIGESTED SLUDGES IN THE LIQUID AREA, A CORRELATIVE REDUCTION OF THEIR VOLUME AND A GOOD TENDENCY TO SEPARATE FROM THE WATER THEY STILL CONTAIN AFTER THEIR EXTRACTION (DEWATER)

4. MANAGEMENT OF THE DIGESTER

DURING THE TREATMENT;

- 4-1 THE **ACTI-ZYME** PRODUCT DILUTED IN WATER IS INTRODUCED IN THE DIGESTER ACCORDING TO THE TREATMENT SCHEDULE, PREFERABLE AT THE SAME TIME AS THE LOADS OF FRESH SLUDGES, OTHERWISE INDEPENDENTLY.
- 4-2 THE MECHANICAL OR GAS MIXING IS MAINTAINED THE FIRST FIVE DAYS FOR FOUR HOURS TO MIX THE TREATMENT WITH THE WHOLE VOLUME OF THE DIGESTER.
- 4-3 THE MIXING IS THEN STOPPED IN ORDER NOT TO DISTURB THE ACTIVITY OF THE TREATMENT AND TO ALLOW THE BUILDING OF DIFFERENT LIQUID LAYERS.
- 4-4 THE BUILDING OF THESE LAYERS MUST BE CONTROLLED BY SAMPLES TAKEN FROM DIFFERENT LEVELS AND BY DETERMINING THE ELEVATION OF THE LAYER OF SLUDGES AT THE BOTTOM OF THE DIGESTER, IN ORDER TO FIND OUT THE INTERFACE BETWEEN SLUDGES AND SUPERNATANT.
- 4-5 FOR ABOUT 15 DAYS THE INTRODUCTION OF FRESH SLUDGE OR OF SLUDGE FROM A PRIMARY DIGESTER SHOULD BE MAINTAINED AT THEIR USUAL VOLUME. IT IS PREFERABLE, IF POSSIBLE, TO MAKE SEVERAL INTRODUCTIONS DURING THE DAY TO AVOID AT THE MAXIMUM A SWEEPING OF THE TREATMENT OUTSIDE OF THE SYSTEM.

4-6 AS SOON AS IT IS NOTICED THAT THE LEVEL OF SLUDGES STARTS TO DECREASE BY BACTERIA DIGESTION THE VOLUME OF INTRODUCTIONS MUST BE SLOWLY RAISED UNTIL THE STABILIZATION OF THE INTERFACE BETWEEN SLUDGES AND SUPERNATANT IS OBTAINED, AT THIS LEVEL, THE DIGESTER WILL HAVE REACHED ITS MAXIMAL BIOLOGICAL CAPACITY AND THE BACTERIA COLONIES HAVE REACHED THE LIMIT OF THEIR DEVELOPMENT.

4-7 THE EXTRACTIONS OF SUPERNATANT MUST START AS SOON AS THE IMPORTANCE OF ITS LAYER HAS BEEN BECOME SUFFICIENT TO BE DETERMINED BY THE FOLLOWING MANNER.

TOWARDS THE BOTTOM: BY SUCCESSIVE SAMPLES WHICH INDICATE THOROUGH THEIR NATURE AN EXTRACTION OF SLUDGES OR AN EXTRACTION OF THE LIGHT AMBER LIQUID PHASE.

TOWARDS THE TOP: BY SAMPLES CONTAINING A BLACKISH WATER.

4-8 FROM THE BEGINNING OF THE TREATMENT EXTRACTIONS OF SLUDGE FROM THE BOTTOM MOST ABSOLUTELY BE AVOIDED BECAUSE IT WILL AT THE SAME TIME REMOVE THE INTRODUCED TREATMENT (SEE 4.6). EXTRACTIONS TO BALANCE THE VOLUME OF INTRODUCED SLUDGE MUST BE MADE BY POURING IN FROM THE TOP OF THE DIGESTER OR AT LEAST FROM THE MIDDLE OF THE VOLUME. THESE INSTRUCTIONS MUST BE MAINTAINED AT LEAST FOR THE FIRST 15 DAYS. A SMALL EXTRACTION CAN THEN BE MADE TO VERIFY THE QUALITY OF THE SLUDGE AND THEIR CONTENT IN RESIDUAL ORGANIC MATERIALS: THE BEST TIME FOR DIGESTING - THE VOLUME AND RHYTHM OF THE EXTRACTIONS. LATER CHECKS EVERY SECOND WEEK WILL BE ENOUGH TO INDICATE IF THE INSTRUCTIONS MUST BE ALTERED.

AFTER TREATMENT AND NORMAL RUNNING OF THE DIGESTER

- 4-9 WATCH THE LEVEL OF THE SLUDGE IN ORDER TO KEEP IT AT A NEARLY CONSTANT LEVEL AROUND THE MIDDLE OF THE HEIGHT. MAKE INTRODUCTIONS ACCORDING TO THIS LEVEL.
- 4-10 MAKE DAILY EXTRACTIONS OF THE SUPERNATANT AT THE LEVEL IMMEDIATELY ABOVE THE SLUDGE.
- 4-11 MAKE EXTRACTIONS OF DIGESTED SLUDGE ACCORDING TO THE PLANNED CYCLIC RATE AS MENTIONED ABOVE (4.8) CONTINUE CONTROL OF TOTAL DRY MATERIALS. AFTER 45 DAYS, ALL PROCEDURES BECOME STABLE AND REGULAR.
- 4-12 KEEP UP THE TREATMENT BY ADDITIONS OF SMALL DOSES OF **ACTI-ZYME** TWICE WEEKLY IN ORDER TO REGENERATE THE BACTERIA AS MENTIONED IN TREATMENT SCHEDULE.

5. CONTROLS AND ANALYSES

BEFORE TREATMENT ON FRESH SLUDGES OR SLUDGES FROM A PRIMARY DIGESTER DEPENDING ON USE OF PRIMARY OR SECONDARY DIGESTER.

- 5.1.1 VOLUME OF SLUDGES INTRODUCED DAILY DURING 8 DAYS BEFORE TREATMENT.
- 5.1.2 TOTAL DRY MATERIALS – VOLATILE MATERIALS – MINERAL MATERIALS – PH OR: B.O.D. – C.O.D. SUSPENDED MATERIALS - RESIDUE AT 500C – PH – IF POSSIBLE TOTAL ORGANIC CARBON.
- 5.1.3 TOTAL NITROGEN KJELDAHL – FREE NITROGEN – PHOSPHORUS AS - POTASH AS K₂O.

5.2 BEFORE TREATMENT ON DIGESTED SLUDGE AND GAS

- 5.2.1 VOLUME OF DAILY EXTRACTED SLUDGE 8 DAYS BEFORE TREATMENT.

5.2.2 TOTAL DRY MATERIALS – VOLATILE MATERIALS – MINERAL MATERIALS – PH OR: BOD – COD – SUSPENDED MATERIALS – RESIDUE AT 500 C – PH – IF POSSIBLE TOTAL ORGANIC CARBON.

5.2.3 TOTAL NITROGEN KJELDAHL – FREE NITROGEN – PHOSPHOROUS P2O5 – POTASH AS K2O – TOTAL ALKALINITY – VOLATILE ACIDS.

5.2.4 DAILY GAS PRODUCTION IN M3 – IN LITRES PER KILO OF VOLATILE MATERIALS – GAS COMPOSITION: % CO2 - % CH4 – RESIDUE – CALORIFIC POWDER.

5.3 AFTER TREATMENT ON DIGESTED SLUDGES AND GAS

1ST ANALYSE: 15 DAYS AFTER BEGINNING OF TREATMENT

2ND ANALYSE: 30 DAYS AFTER BEGINNING OF TREATMENT

3RD ANALYSE: 45 DAYS AFTER BEGINNING OF TREATMENT

5.3.1 TOTAL DRY MATERIALS – VOLATILE MATERIALS – MINERAL MATERIALS - PH OR: - B.O.D.- C.O.D. – SUSPENDED MATERIALS – RESIDUE AT 500 C – PH – IF POSSIBLE TOTAL ORGANIC CARBON.

5.3.2 VOLUME EXTRACTED DAILY FROM THE 15TH DAY.

5.3.3 TOTAL NITROGEN KJELDAHL – FREE NITROGEN PHOSPHORUS AS P2O5 – POTASH AS K2O – TOTAL ALKALINITY – VOLATILE ACIDS.

5.3.4 DAILY GAS PRODUCTION IN M3 - IN LITRES PER KILO OF VOLATILE MATERIALS – GAS COMPOSITION: % CO2 - % CH4 – RESIDUE – CALORIFIC POWDER.

6 RESULTS TO EXPECT

6.1 INCREASE IN PERCENTAGE OF DRY MATERIALS IN THE DIGESTED SLUDGE : ABOUT 5%

6.2 REDUCTION IN VOLUME OF THE EXTRATIONS OF DIGESTED SLUDGE: 30% COMPENSATED BY EXTRATIONS OF SUPERNATANT AND WATER. THIS PERCENTAGE DEPENDS ON THE DESIRED QUALITY OF THE SLUDGE (TO BE USED AS FERTILIZER-COMPOST)

- 6.3 IMPROVEMENT OF FILTERABILITY OF THE SLUDGE OR OF THEIR DEWATERING ON DRYING BEDS. TESTS TO MAKE BY PROGRESSIVE REDUCTION IN THE PROPORTION OF COAGULANTS FOR FILTERING OR CENTRIFUGATION. A REDUCTION OF MORE THAN 50 % IS POSSIBLE ACCORDING TO THE RATE OF DIGESTION AND THE RETENTION TIME IN THE DIGESTER.
- 6.4 INCREASE IN VOLUME OF THE GAS PRODUCTION. AT LEAST 30% IMPROVEMENT OF THE QUALITY ABOUT 2 % OF CH₄ OR MORE AND CO₂ LESS.
- 6.5 INCREASE OF THE BUFFER CAPACITY OF THE DIGESTER: RISE OF 400 TO 500 DEGREES IN ALKALINITY.
- 6.6 POSSIBILITY OF USING THE SLUDGE AS FERTILIZER BY CHANGE IN TIMING OF INTRODUCTIONS AND EXTRACTIONS. IN THAT CASE, THE BEST BALANCE N – P – K /ORGANIC MATERIALS MUST BE FOUND OUT ACCORDING TO THE DIFFERENT TESTS OF DIGESTION TIMING REALIZED. A REDUCTION OF THE DIGESTION TIMING IN A REASONABLE LIMIT HAS LITTLE INFLUENCE ON THE DEHYDRATION OR CENTRIFUGATION OF THE SLUDGES IN VIEW OF THEIR CONDITION.
- 6.7 **IMPORTANT:** BACTERIOLOGICAL ANALYSIS CAN PROVE THAT SLUDGES TREATED WITH **ACTI-ZYME** NEED NEITHER PASTEURIZATION NOR STERILIZATION TO RESPECT HYGIENIC RULES IN CASE OF USE AS NATURAL FERTILIZER AS WELL IN LIQUID AS IN DRY FORM. (NON-TOXIC)

7. **ECONOMIC STATEMENT**

- 7.1 **CALCULATE THE ENERGY AND FINANCIAL VALUE OF THE GAS PRODUCED AND COMPARE IT WITH THE VALUE OF Kwh OF ELECTRICITY OR OF ONE LITRE OR KILO OF HEATING OIL.**
- 7.2 **CALCULATE VALUE OF THE REDUCTION IN CONSUMPTION OF ANIONIC OR CATIONIC POLYMER COAGULANTS OR OTHER COAGULANTS EMPLOYED FOR TREATMENT OF THE SLUDGES.**
- 7.3 **THE INCREASE OF THE CONTENT IN DRY MATERIALS OF THE DIGESTED SLUDGES CONTRIBUTES TO A DECREASE IN COST AND MANIPULATION AND STOCKING WHICH CAN BE CALCULATED RELATIVELY TO EACH CASE.**
- 7.4 **THE MANAGEMENT OF SUB-CONTRACTING OF THE MANAGEMENT OF SLUDGES AS FERTILIZERS CAN BE SOURCE OF INCOME REDUCING THE MANAGEMENT COST OF A PLANT WHEN THE QUANTITIES ARE SUFFICIENT TO ALLOW ITS SALE.**