



A Study on the CTC Method Grinding Machine in Black Tea Processing at PTPN IV Unit Kebun Sidamanik

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Abstrak

Pengolahan produk teh hitam dikategorikan ke dalam dua metode: (1) Orthodox dan (2) CTC (Crushing/Perajangan, Tearing/Penyobekan, dan Curling/Penggulungan). Metode ini dilakukan dengan melaksanakan secara langsung kegiatan di perusahaan/pabrik melalui teori yang kemudian diterapkan dalam bentuk kegiatan atau Praktek Kerja Lapang (PKL). Adapun kesimpulan yang dapat diambil dari kegiatan Praktek Kerja Lapang adalah sebagai berikut: Perkebunan Sidamanik merupakan salah satu dari 24 perkebunan teh di bawah PTPN IV Unit Kebun Sidamanik yang terletak di Kecamatan Sidamanik. Hasil produksi teh hitam CTC pabrik Sidamanik selanjutnya dikirim ke pabrik seinduk untuk kemudian nantinya dicampur dengan disana dan komposisinya diatur oleh bagian teknologi karena produk teh hitam CTC pabrik Sidamanik belum memiliki label jual. Di pabrik Sidamanik, penggilingan dilakukan sebanyak dua tahap menggunakan mesin Rotorvane (RV) Φ 15" pada penggilingan pertama dan penggilingan kedua menggunakan Teaman 36" CTC Machine 4 Cut yang memiliki 4 pasang roll berurutan. Kapasitas Rotorvane adalah 484.739,3533 kg pucuk layu/jam, kapasitas equivalen terhadap pucuk segar 581.710,4923 kg pucuk layu segar/jam, dan kapasitas equivalen terhadap teh kering 121.810,1771 kg teh kering/jam. Kapasitas gilingan CTC adalah 18.274,7704 kg bubuk giling/jam, kapasitas equivalen terhadap pucuk segar 21.930,6017 kg pucuk layu segar/jam, dan kapasitas equivalen terhadap teh kering 4.592,2680 kg teh kering/jam.

Kata Kunci : Kajian, Mesin Penggiling Metode Ctc, Pengolahan Teh Hitam

Abstract

Black tea processing is categorized into two methods: (1) Orthodox and (2) CTC (Crushing, Tearing, and Curling). These methods are implemented through hands-on activities at the company/factory based on theoretical knowledge, which is then applied in the form of field work practice (PKL). The conclusions drawn from the field work practice are as follows: The Sidamanik Plantation is one of 24 tea plantations under the Sidamanik Plantation Unit of PTPN IV, located in Sidamanik district. The CTC black tea produced at the Sidamanik factory is then shipped to the main factory for lending there, with the composition regulated by the technology department, as the CTC black tea from the Sidamanik factory does not yet have a label. At the Sidamanik factory, grinding is performed in two stages using a 15" Rotorvan" (RV) machine for the first grinding and a 36" Teaman CTC 4-Cut machine with four sets of sequential rollers for the second grinding. The Rotorvane's capacity is 484,739.3533 kg of withered tea leaves per hour, equivalent to 581,710.4923 g of fresh withered tea leaves per hour, and equivalent to 121,810.1771 kg of dry tea per hour. The CTC plant's capacity is 18,274.7704 kg of ground tea per hour, equivalent to a capacity of 21,930.6017 kg of fresh withered tea leaves per hour, and equivalent to a capacity of 4,592.2680 kg of dry tea per hour.

Keyword : Study, CTC Method Grinding Machine, Black Tea Processing

INTRODUCTION

Basically, black tea product processing is categorized into two methods: (1) Orthodox and (2) CTC (Crushing, Tearing, and Curling) (Prihastiti, 2024). Orthodox black tea is tea that is processed through a withering process of around 16 hours, followed by rolling, fermentation, drying, sorting, until it forms the finished tea. Meanwhile, CTC black tea is tea that is processed through chopping, tearing, and rolling the wet leaves into powder, then continued with fermentation, drying, sorting, until it forms the finished tea (Kusuma, 2020)

The CTC black tea milling process is the most important process in the CTC black tea production process, because this process is what differentiates CTC black tea from orthodox black tea. In the CTC black tea milling process itself,



there are two stages of the milling process: preparatory milling and CTC milling. The preparatory milling aims to make CTC milling more efficient, while the CTC milling serves to completely crush the leaves so that almost all leaf cells are broken and produce more enzymatic oxidation of polyphenol compounds (Amalia, 2024).

The results of the preparatory milling process will influence the output of the CTC milling process. In this case, the machinery operated during the black tea milling process is crucial for the final milling results and the impact that will occur on subsequent processing (Amalia, 2024). Therefore, a study is needed to estimate the level of effectiveness of the machines operating at the milling station to obtain good black tea milling results that meet the requirements for further treatment in the CTC black tea processing process (Putratama, 2009).

RESEARCH METHODOLOGY

In preparation report this, the author use methods and some technique writing with the intention is to make it easier inside data collection, so that report This can arranged with more good and appropriate with situations and conditions. As for the method the writing used in compilation report This among others (ANNAFI'AH, 2024):

1. Descriptive method

In preparation report This writer use method descriptive in argue and explain problem in a way detailed in accordance with existing data and facts (Wanaputra et al., 2020).

2. Observation

This method done with carry out in a way direct activities in the company / factory through later theory implemented in form activity or Practice Work Field (PKL).

3. Interview

Writer collect data with do ask answer in a way directly. This is done For get something accurate and clear information needed in compilation report (Wanaputra et al., 2020).

4. Literature study

In terms of This writer collect data with method look for as well as read literature in the form of journal research, articles, and *e-books* on the internet as well existing books relation with discussion problem (Margaretha, 2023).

RESULTS AND DISCUSSION

Production process CTC Black Tea at Sidamanik Plantation Unit of PTPN IV

Type of activity

Types of activities carried out is learn and know through observation and interviews regarding the processing process tea black CTC at Sidamanik Plantation Unit of PTPN IV (Persero) Sidamanik Plantation (hereinafter referred to as CTC) written Sidamanik Plantation), especially do comparison use machine mill CTC preparation and grinding (Jami et al., 2022).

Tools and Materials for Activities

As for the tools and materials used during Practice Work Field at Sidamanik Plantation is as following :

Tool

1. Machine mill preparation (Rotorvane 15”)
2. Machine CTC mill
3. Meter
4. Dry bulb and wet bulb thermometers

Material

1. Tea leaves

Process Stages

Processing shoots leaf tea is a process of changing composition chemistry shoots leaf fresh tea becomes results processed products that can bring up the desired properties of the brewed water, namely color, taste and aroma. Criteria This can achieved with material raw and how to good processing that is in accordance with conditions required and supported by conditions good equipment and machinery (KUSUMO, 2020).

Processing tea black at the Sidamanik Plantation factory use two systems, namely CTC (Crushing, Tearing, Curling) and Orthodox. However, what is discussed is just a CTC process, especially in the milling process which includes mill CTC preparation and grinding. This due to the processing process tea black CTC still in a word new used in Sidamanik Plantation so that required something study about effectiveness use machine grinder as material input to Sidamanik Plantation.

Transportation and Receipt of Raw Materials

a. Transportation of Shoot Raw Materials

Shoot tea that has been weighed at the top of the hill Then transported to factory. Transportation shoots at Sidamanik Plantation done twice a day namely at 10.00 and 13.00. Transportation done with the truck that was given cover, so that the shoots avoided from ray sun. Capacity truck that is 2.5 tons or about 100 waring sacks. Top contents each waring



sack/ container maximum 25 kg and not crammed with size The circumference of the waring sack/ container is 126-140 cm and the height is 100 cm condition Already tied up. Attempted transportation with truck No cause shoots crushed Because shoots when arrived at the factory must in condition whole, fresh/ not nyeupan with percentage damaged / crushed maximum 5%. Capacity truck customized with size wide tub trucks in each garden, maximum 7 (seven) waring sacks/ containers per m2. However in fact, still happen transportation with cargo truck excessive. This is should No permitted and carried out handling of shoots tea No damaged during transportation (Maghfiro et al., 2023).

b. Receipt of Raw Materials

After arriving at the factory, the top weighed repeat and do inspection based on the Order Letter (SP). Weighing done on the spot weighing truck (station) scales). After that garden and bring fresh shoots, trucks along with contents weighed. Then truck going to room withering For lower fresh shoots from truck. After the fresh shoots are unloaded, the truck empty weighed again in place weighing. At the time weighing ongoing, passengers and goods others who don't related with weighing shoots No justified For follow weighed (Marvin et al., 2025).

Principle Work Weighbridge

Vehicle loaded on top bridge weigh will pressing bridge slab floor weigh. Because There is style gravity, load cell receives burden vehicle loaded and then transfer it to the weighing indicator in the form of electronic input data (Ramanda et al., 2021). The output is in the form of appearance number will appears on the weight meter with scale smallest as much as 5 kg.

Ways of working Weighing Station

1. Truck loaded leaf tea enter to bridge weigh the passengers inside truck down except driver.
2. Operator records number vehicle with cargo said, origin department, and entry hours.
3. Reading operator weight displayed by the weighing indicator, weight the become heavy gross.
4. Vehicle loaded enter to factory going to part withering For lower leaf tea For withered.
5. Vehicles that have been empty return Again to station weigh For weighed back and will obtained mark from Tara.
6. The operator will record gross and tare data obtained and then count mark net (leaves incoming tea to factory) with method cut gross with scales empty (tare).
7. Operators also calculate piece must For heavy sacks used during transportation as much as 80 kg.

Note : In the event of certain usually given piece addition like piece by 10% for leaf tea in condition wet, 8% for leaf tea in condition rather wet, and 4% for condition leaf dewy tea

Pick and Shoot Analysis

For evaluate implementation picking every good day method picking, used excerpt and the result, it is necessary implemented analysis picking consisting of from analysis shoots and analysis pick. Analysis shoots and analysis pick This done after disclosure (Triardianto et al., 2025).

Quote Analysis

Analysis pick is separation according to the top formula results excerpt (without potesan). Uses analysis pick is For evaluate accuracy implementation policy picking and conditions plant,

Exposure

Exposure functioning For leveling fresh shoots in the trough wither so that the thickness evenly. Water evaporation is influenced by the thickness and evenness of the surface. too much exposure. Too much exposure thick will obstruct flow air from part under the withering trough to shoots located in the part on so that degrees withered No uniform (Pratama et al., 2022).

Fresh shoots that have been weighed placed on a moving monorail around the withering trough. Then fresh shoots are lowered from the monorail, entered in the withering trough and leveled. With limit maximum each withering trough 1,500 kg. Height of the overlay not enough more than 30-40 cm.

Exposure shoots done from opposite ends direction with a fan, so that fresh air is retained by the shoots that have been exposed at the end of the withering trough. Then done calculation with scattering. Calculation is reversal top. Reversal This aim For move position the top that was originally on top moved to part lower so that withering ongoing perfect, besides That For separate shoots that are still sticky (Syahputra, 2024).

Fresh air used streamed with using a fan. Function fresh air is For speed up the wilting process and remove water from the surface leaves. After the exposure, it is done analysis shoots and analysis excerpt (Nurjanah, 2021). Conditions For analysis shoots at least 65% and optimally 70%, while For analysis pick 70%.

Withering

Withering in essence lower shoot water content up to 68-76% wet basis for the CTC process. The time required for the wilting process is 14-16 hours. The temperature during the wilting process in the factory Sidamanik range between 20-22 °C depending from weather outside, if Evening day the temperature Can below 20 °C. The size the air that flows through the withering trough of the fan is of 15-20 CFM/kg (Khisaa & Iqbal, 2001). For get results good wilt, need done reversal shoots 2-3 times and if shoots too dry, fan stopped and the withering trough door opened so that quantity the air that hits shoots decreased. Percentage flatness wilted in the factory Sidamanik is around 90%.



Figure 1. Tea Leaf Withering Process

It is a transfer process shoots from room withering to room milling. Extraction shoots withered with using barrels that are passed by colored monorails yellow. Then shoots entered to hallway towards GLS.

During the withering process, there are things that influence the process, including :

Withering carried out in factories Sidamanik range between 14-16 hours. Excessive wilting fast will produce smelly tea fragrant but properties other less. Meanwhile long withering will produce tea with brewed water colored dark, astringent taste and smell No delicious. Thick layer shoots in the trough withering in the factory Sidamanik is about 30-40 cm, depending from many production. If production currently a lot, then usually thick expanse more thick from 40 cm. However expanse shoots tea No may too thick Because can cause hot air No evenly so that withering become longer (Nsanzabera et al., 2024).

For know water content at the time withering whether Already in accordance standard or not yet, that is with method take sample as much as ± 100 g of shoots withered in a way random from the withering trough every ± 6 hours at the beginning disclosure, middle, and approaching down wilted. After that from sample take 3-5 g then thinly sliced with thickness ± 1 mm and measured level the water with Mettler Toledo tools (Seenivasan et al., 2008). When results measurement water content is already reaches 69-73% wet basis, then results withering quick entered to room milling. Meanwhile that, if leaf tea No reach level determined wilting so time withering will plus.

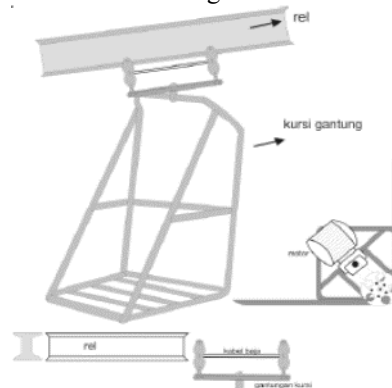


Figure 2. Monorail Equipment

Withering trough in space withering totaling 46 units. Each trough has a different CFM (Cubic Feed per Minute), the CFM ranges in size between 22,000-28,000 CFM. The difference this CFM is large depends big fan power (kW) per withering trough (the more large kW fan, then the more large CFM). Principle Work tool This is lower fresh shoot water content up to specified water content. Hot air mixed with fresh air around the withering trough. Mixed air This exhaled to in the withering trough with blower air driven by an electromotor. The wilting process CTC shoots only use just fresh air.

Heat Exchanger (HE) is tool For produce air the heat that will used For lower water content in fresh shoots. Fuel used is Solid Fuel (BBP) in the form of wood burn because IDO (International Diesel Oil) has No used still at the factory Sidamanik. For stage usage, water content of wood fuel used maximum 20% bk (Seenivasan et al., 2008).

Principle Work tool This is burning material burn wood burn that will produce the heat that will regarding the plates in space combustion. Then, energy hot will heat the air inside. Hot air This sucked by the main fan and circulated going to trough withering trough through ducting. The main fan is a fan measuring big with Power of 40 HP. HE does not only produce air hot clean flowing water to trough withering, but there are also air hot dirty then thrown away to environment.



Machinery and Equipment Analysis Shoot

Analysis shoots done For know quality passages produced in each sluggishness. Analysis This done in the room analysis located in space withering. The equipment used includes digital scales, sample analysis containers, tea sample containers, and small tampers. At the Sidamanik factory, there is one set of equipment for sample analysis and collection, as shown in the picture below.

This process is an important process because of the formation process quality tea in a way physical and chemical. In the CTC process, no sorting process is carried out wet. However, according to with the name, namely Crushing, Tearing and Curling, the grinding process includes 3 things, namely tearing (cutting), pressing and rolling.

Purpose of milling and rolling that is :

1. Zoom out size shoots tea withered ;
2. Grind shoots tea agar liquid cell go out as much as possible so that happen contact with oxygen, enzymes and substrates so that happen oxidation enzymatic ; and
3. Optimizing the formation of inner quality.

At the factory Sidmanik, CTC process only has 1 path. For milling beginning used machine Rotorvane (RV) “15 and the number There are 4 CTC machines. Milling in the CTC process started from when shoots tea withered lowered from room withering to room milling through funnel towards the GLS (Green Leaf Shifter). GLS is used For separate shoots withered with dirt like stem, sand, metal so that dirt No damage CTC knife and make congested CTC knife. From GLS, enter to the RV for done milling beginning. On the tool this, the top Not yet fully smooth. The purpose of grinding beginning This For make it easier milling next in the CTC machine. After entering the CTC, the cut shoots will torn again, pressed and rolled so that produced powder very fine tea. Next to the CFU (Continuous Fermenting Unit) for the fermentation process.

this process shoots leaf tea rolled up use Rotorvane (RV). Factory Ciater choose use machine mill preparation Rotorvane than Barbora Leaf Conditioner (BLC) with consideration use tools used in the stage Next. Use of BLC for roll shoots withered will need more Lots CTC knife for cut and tear shoots withered before enter to the fermentation tray. Meanwhile that, use Rotorvane need more A little CTC roll knife for cut and tear shoots wilted. From the condition said, the results obtained also follow affected. In the process that uses mill BLC shoot preparation ground after pass the 3rd roll still own undersized uniform. While in the process that uses RV, the shoots ground that has been pass the 3rd roll knife has been own uniform size so that can quick continued at the stage fermentation. In short, to get results optimal grinding, the CTC process with BLC requires a minimum of 4 CTC roll knives while the CTC process with RV requires a minimum of 3 knives CTC roll (Seenivasan et al., 2008).

In the CTC process, almost all of it influenced tool currently power work used only just For control the way equipment (Konar & Datta, 2012). For support this process, temperature air room is 18-24 °C and humidity relatively the air is 90-98%. Water content of powder tea results milling is 72.4% wet basis. For maintain temperature air and humidity relatively required air and can produce good tea so humidifier installed for guard humidity air and temperature room. During the milling and rolling process, occurs change physique and chemicals on the shoots that have ground.

Change Physique

Change physical changes that occur at the shoot tea wilting in the CTC process is (1) Shoots tea withered will separated from dirt like stalk, sand and metal using GLS; (2) Top tea will experience downsizing size become powder rough tea use Rotorvane ; (3) Powder rough tea will experience tearing, pressing and rolling become powder tea fine using CTC; and (4) Powder fine tea will experience change color become green brownish.

Chemical Changes

Change chemistry during the milling process This that is occurrence incident oxidation enzymatic that is Because existence contact between substrate polyphenols with enzyme polyphenols assisted oxidase with oxygen. Reaction This will make color powder tea become brownish Because results from reaction This is compound quinones that cause powder colored chocolate(Konar & Datta, 2012).

Rotorvane is tools used For cut shoots withered become parts that are sized more small. Principle Work tool This is shoots withered brought thread towards vanes, shoots withered move forward. Because there is a resistor on the edge of the RV, then moving shoots proceed squashed by the resistor. There are vanes in the direction opposite (review vanes) which causes shoots return to back and crushed Again so that its size more smooth, and can pass gap between the end plates.



Figure 3. Rotorvane (RV) “15

This tool functioning For cutting, tearing and rolling shoots so that shoots can granular. On the CTC roll there are 2 rolls with different speeds. different. Roll 1 has speed of 70 rpm while roll 2 is 700 rpm. Roll 1 is the base while roll 2 is the base. cutter. Direction of rotation these two rolls is in the same direction. The distance between both rolls are 0.002 inch.

Each CTC roll has 2 grooves, namely channel helix and groove vertical. Helical groove functioning For emit the shoot in the middle both rolls, while vertical groove as cutter what makes shoots the more smooth. Each roll has 15 segments knife. One segment The width is 2 inches, and there are 8-10 teeth (Tooth per Inch). For the CTC milling line in the factory Ciater, CTC 1 every 8 tooth segment, CTC 3 to CTC 4 each 10- tooth segment. Settings its use Can changed in accordance with condition material processed raw materials (Dey, 2014).

For hone channel helix using a milling cutter, medium For hone knife cutter used cheaser. Amount channel The helix on the CTC 8 TPI is 50 grooves. And on the CTC 10 TPI it is 60 grooves. Usage CTC 8 TPI blades have a maximum life of 100 hours, while CTC 10 TPI blades have a maximum life of 80 hours. After that must sharpened Again For guard sharpness.

Principle CTC roll work is crushing, rolling and tearing shoots withered done by the CTC roll which has speed different. The roll driven by an electromotor. Rotation This cause shoots the previous wilt Already cut in RV or BLC to granular powder. CTC roll schematics and photos can be seen in the image below This :

Fermentation (Oxidation) Enzymatic)

Fermentation is a process of formation properties the most important tea in processing tea black. This process more appropriate If called as an oxidation process enzymatic, because the reaction that occurs is reaction oxidation compound polyphenols with enzyme polyphenols oxidase with existence oxygen. Properties tea black is the most important like color, aroma, taste, and color of the brewed water arise during this process (Deka et al., 2021).

Fermentation in factory tea is mixed up substances contained within fluid squeezed cells go out during the subsequent grinding process experience change chemical with help enzymes and oxygen from air (Lehninger et al, 1951; Adiprayoga, 1971; Eden, 1958). The purpose of oxidation enzymatic This is For give chance occurrence reaction oxidation enzymatic between substrate polyphenols with enzyme polyphenols oxidase in shoots tea aided by oxygen.

Oxidation compound polyphenols, especially epigallocatechin and its derivatives will produce quinones which then will condensing more carry on become compounds bisflavanol, theaflavin, and thearubigin. Condensation and polymerization processes walk form substances No dissolved.

total amount between theaflavin and thearubigin affect the taste of tea (Roberts, 1958). For tea quality dry good, that is Good its strength and freshness, then amount tea flavin and tea rubigin possibility have comparison 1 : 10 or 1 : 12. But For lack of tea freshness and strength, possibility have ratio 1 : 20 or more (Harler, 1970). Tea flavin relate close with characteristics of brewed water (liquor) such as brightness, briskness, and strength. While tea relate with apparition especially color of brewed water (Pou & Tripathy, 2020).

In the CTC system, the fermentation process carried out in the CFU (Continuous Fermenting Unit). The CFU is a walking conveyor. After exiting from CTC machine, powder tea quick enter to the CFU via conveyor. In CFU there are tool functioning rake For leveling powder tea that goes through CFU so that thick expanse powder evenly. In addition There is working reverser For flip powder the tea is in CFU so powder that was originally be under move to above and above move to down. Throughout powder tea move via conveyor on CFU, powder little by little changed color become brownish.

Actually reaction oxidation enzymatic Already happen since shoots withered torn by Rotorvane. Since shoots withered fall from GLS and enter to Rotorvane or BLC, liquid cell shoots out. Liquid cell the contain compound polyphenols. Compounds the Then react with enzyme polyphenols oxidase in leaves. Due to contact with air around (oxygen), then happen reaction oxidation enzymatic. Then powder tea going to drying (Feng et al., 2020).

Fermentation process must supported with existence conditions that can ensure the success of the process. Therefore that, is necessary existence process control and control quality.



Process Control

- Control temperature and humidity use a humidifier to keep the temperature maintained in the range 18 – 24 °C. If temperature below 18 °C, then the fermentation process will walk slow. Meanwhile if temperature too high, then enzyme will damaged. Meanwhile humidity required air is 90 – 98%. If humidity air below 90 %, then cause processed powder will experience water evaporation and lowering quality tea.

1. In the CTC Process, control time Already regulated by the tool. The running of CFU has been set so that time For fermentation Already arranged.
2. fermentation time in the CTC system is 60 – 120 minutes. The time required For fermentation in the CTC system is sufficient short, because in the CTC system the process is continuous.
3. Arrangement condition powder during the fermentation process ongoing. What is meant by condition powder is condition powder during the fermentation process. Includes temperature powder, thickness powder, evenness powder and water content of the powder. Temperature powder during the fermentation process attempted 26.7 °C. Thickness powder set 6 – 10 cm, and try to powder evenly on each tray. Settings thickness powder with rake and turner. Settings water content of powder fermented is 72.4% wet basis (for CTC).

During oxidation enzymatic, occurs changes in compounds polyphenols that is catechins. Catechins that undergo change is epigallocatechin and epigallocatechin error, which with the presence of O₂ from air and polyphenols oxidase, catechin will experience reaction oxidation enzymatic form orthoquinone. Some orthoquinones will precipitated by proteins (Harler, 1963). Orthoquinone will condense form bisflavanol, then experience condensation Again form colored theoflavin yellow and will experience condensation form colored thearubigin red and brown (Kirk and Othmer, 1965). Tearubigin along with available protein form compound No dissolved.

According to Pintauro (1997), theaflavin will formed in amount maximum in the first and second hours from stage fermentation. In the next hour, the compound This will down and followed rise compound tearubigin. Difference both of them will also determine characteristic brew tea such as briskness (freshness), quality, color and strength (taste strength). Theaflavin more Lots formed at temperature low (Hoque et al., 2025).

Change physical events that occur during the oxidation process enzymatic is produced hot as consequence reaction oxidation enzymatic and condensation. In addition, it also occurs change color powder tea from colored green become red copper as consequence formation colored theaflavins yellow bright and colored thearubigin red chocolate.

Compounds that give tea its aroma is compounds aldehyde which is results oxidation from compound carotenoids. Oxidation compound carotenoids produce substance volatiles that give tea its aroma (Stahl, 1969). According to Bokuchava and Skobeleva (1969), what gives tea its aroma is compound aldehyde as results oxidation compound amino acids with quinone and as results reaction amino acids with simple sugars. While according to Deuss (1915) in Bokuchava and Skobeleva (1969), said that the aroma of tea produced from results decomposition chain glycosides tannin tea, produce tannin simple and carbohydrates, which are then experience transformation into esters. Pamaswamy (1958) suggested that the aroma will increase Good when level soluble solids, total substances that can be dissolved oxidized, theaflavin and soluble substances in acid and oxidized, formed in a large number. But There is limit certain to obtain a good aroma, because aroma can is lost If oxidation enzymatic too long.

Oxidation results expected enzymatic is if powder tea has own color red brownish (brown) copper) and aromatic distinctive (fragrant). Examination quality results fermentation done with the Green Dhool Test, which aims For give evaluation powder tea results oxidation enzymatic For determine duration oxidation optimal enzymatic. Taste assessment is carried out with weighed 2.8 g and brewed with hot water for 6 minutes. Then pour in the water in bowl brewing. Taste assessment is carried out with tasting the brewed water. Criteria his assessment is water color (colory), briskness, strength and color dregs. Color of dregs brew done with method move dregs brew to on closed cup, and observed color the dregs (Pou et al., 2019).

Drying is a flow process air heat on powder results fermentation so that obtained dry powder. Drying in processing tea black in the factory Sidamanik done with VFBD (Vibro Fluid Bed Dryer). Hot air is used For drying originate from air heated outside with a Heat Exchanger that uses material burn material congested in the form of wood burn. The hot air in question here is hot propagation results from burning.

The hot air produced Then enter through ducting next door under FVBD due to existence pull from the main fan. Next air hot clean streamed towards FVBD and air hot dirty thrown away to environment consequence ID fan suction through ducting. Inside the FVBD there is a blower that makes powder tea moving dancing during the drying process. During the drying process, it will There is fibers from powder sucked tea to dry cyclone and wet cyclone. The fibers are sucked by the cyclone wet returned to the fermentation unit Because fiber the Still can processed. While For fibers sucked up by dry cyclone enter to sack and thrown away Because usually the one sucked in by the cyclone is dry in the form of dust and not can processed.

In addition, drying in processing tea black can also be kill existence microbes because at temperature tall microbes No hold on and die. Available water content achieved drying process in the factory Ciater is 3% wet basis.

Drying in the CTC system with use tool Vibro Fluid Bed Dryer (VFBD). After the grinding and oxidation process enzymatic, powder tea quick enter to drying via conveyor. Temperature incoming air to in machine dryer VFBD (inlet temperature) is of 110 – 120 °C and temperature exiting air (outlet temperature) 85 – 90 °C.

Time required for the drying process CTC system in Factory Tea Sidamanik is 18-24 minutes. Drying on CTC is longer and the temperature is more tall than in drying in Orthodox. This is Because water content of powder tea on the CTC system more tall than the Orthodox system so that need more time and temperature tall For Can get low water content.

Powder tea enter onto the VFBD plate/tray. Hot air will about powder tea from part under VFBD with blower assistance. On the VFBD, there is also a functioning ball breaker For destroy lump powder tea. Different with Orthodox system, in VFBD not there is oscillator used For leveling powder on the drying plate. In VFBD, the drying plate move in a way vibro (vibration), so that powder move dancing on the drying plate and making thick powder evenly. So it's not need oscillator Again For leveling powder. In VFBD, there are also three principle cyclones his work The same with on FBD.

Principle Work tool This that is drying powder tea on the VFBD tray. Powder tea move proceed with dancing movements until obtained powder tea dry. Hot air is used For drying originate from air heated outside with a Heat Exchanger that uses material IDO burn. Fresh air that will be thrown away to outside, in through gap income adjacent down. Enter air the Because pulled by the main fan. After the air enter, then through pipe gaps leading to chimney expenditure. While For fresh air used For drying, entering through gap part above drawn by IDfan. Then, air enter through gap and pass through part under VFBD and used For drying powder tea.

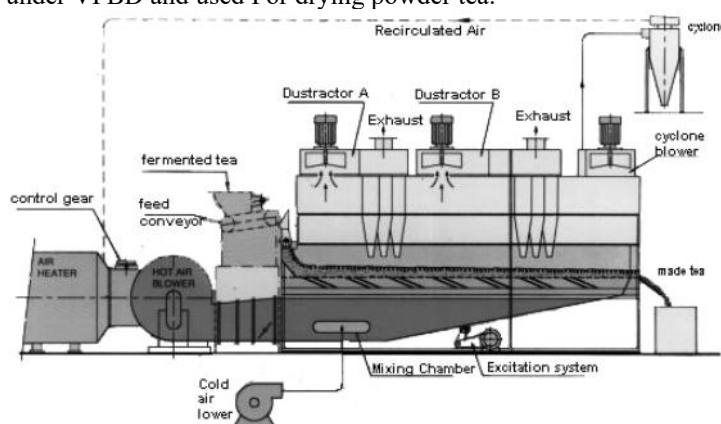


Figure 4. KilBurn Vibratory Fluidized Bed Drying (VFBD)

Sorting Dry

Sorting basically dry is effort For get product tea uniform and good black size, shape and weight, besides tea the must clean from dirt, bones, or fibers leaves. Based on base said, then implementation sorting dry includes : cutting / reducing sizing, sifting, cleaning from dirt, and blow tea For get heavy uniform particles. Powder The minimum smoothness must be 70%, BP must be 5%. Don't too Lots treatment in the section sorting Because can cause color become dull

Powder tea results drying moved to room sorting dry with conveyor. Separation based on size particle use machine chota shifter. Separation based on content bone or fiber use midleton and vibrex. Separation based on heavy type using winnower. In sorting dry this is also done downsizing size parts unripe tea fulfil standard with use tool cutter and crusher (druckroll and crusher).

Handling Product

Packing

Packing is pouring powder tea to in packaging in accordance with weight that has been determined each grade. Heavy for each grade is different in each paper sack. The packaging used is a sack made of from paper but in the section in coated aluminum foil.

Packing have objective :

1. Protect powder tea from contamination microbes or dirt physique ;
2. it easy inside transportation and marketing ;
3. Repair appearance in frame interest sales ; and
4. it easy inside storage in warehouse (effectiveness place).

Packing For tea black CTC in factory Sidamanik Not yet given naming Because factory Sidamanik Not yet has a sales label. Production results tea black CTC factory Sidamanik furthermore sent to factory sibling For Then later mixed with product from there and its composition regulated by the section technology. Products results production in the factory Sidamanik No Can blended directly because results production tea black CTC plain medium own characteristics appearance strong but the taste is lacking. Tea yield So the resulting taste and aroma No Can compete like results tea So from plains tall so that need done mixing in the factory siblings.



Storage

Although stage processing tea final is packing, but after packed tea done storage in warehouse storage. Storage space The same with room packing. This is For make it easier arrangement, so that after done packing, tea in sack can done chopping and direct arranged in the room the.

Storage in chop-chop shape. One chop consists of on 1 bottom pallet, 1 bottom pallet consists of over 20 sacks. The maximum bottom pallet height is 220 cm. This For keep the tea in the part lower No squashed and not damaged. Then, it was closed plastic the previous cover tied up with plastic strapping. Finally, for the chop that is ready marketed marked with the word “OK”.

Machinery and Equipment Packing and Storage Temporary

Tea Bin

Tea bin is a container temporary powder tea that will done packing after from sorting dry. Tea bin shaped like a hopper (cylinder) with funnel expenditure in the section the bottom is shaped cone.

It is tool For leveling powder tea in a paper sack and arrange the thickness of the paper sack becomes not enough more than 20 cm. After the vibrator, the paper sack that has been filled tea placed on top of the bag shaper. In the section on top of the bag shaper there is iron as regulator height of paper sack. So that how thick is the paper sack ? more from 20 cm.



Figure 6. Bag Shaper

Vibrator is working For leveling tea dry to in all paper sack and collecting section tea dry fallen so that can used again. Scales functioning For weigh powder tea that has been in a paper sack to achieve desired weight.



Figure 7. Scales

Capacity Calculation Of Preparation Milling Machines And Ctc Milling Machines

Milling stage in the processing process tea black CTC in factory Sidamanik consists of from 1 lane. On the lane the there is machine mill preparations in the form of *Rotorvane* “15 and the machine CTC mills as many as 4 units. Second type machine the own different capacities with its function is also different.

Calculation

a. *Rotorvane* (RV)

Calculation capacity with approach *batch*, assumptions No existence blockage during the process.



Dimensions for 1 round (1 wave)

Shaft diameter : 15 inches = 0.381 m

Shaft length : 40 inches = 1.016 m

Shaft Volume : 0.1159 m³

Cylinder diameter : 40 inches = 1.016 m

Cylinder length : 40 inches = 1.016 m

Cylinder volume : 0.8240 m³

Total volume : (0.8240- 0.1159) m³ = 0.7081 m³

Around axis : (π x 0.381 m) = 1.1963 m

Around cylinder : (π x 1.016 m) = 3.1902 m

Total circumference : (3.1902 - 1.1963) m = 1.9939 m

Bulk density : 118.6446 kg/ m³

Round cylinder : 49 rpm

Speed round : (49 rpm x 1.9939 m/ rev)

= 97.7031 m/ minute = 5,862.1836 m/hour

Displacement length : 1,106 m (assumption each transfer reach 1 round)

$$\begin{aligned} \text{Kapasitas RV} &= \frac{\text{volume}}{\text{panjang perpindahan}} \times \text{bulk density} \times \text{kecepatan} \\ &= \frac{0,7081 \text{ m}^3}{1,106 \text{ m}} \times 118,6446 \text{ kg/m}^3 \times 5.862,1836 \text{ m/jam} \\ &= 484.739,3533 \text{ kg pucuk layu/jam} \end{aligned}$$

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Capacity RV equivalent to fresh shoots :

$$\begin{aligned} &= \frac{100 \text{ kg pucuk segar}}{83,33 \text{ kg pucuk layu}} \times 484.739,3533 \text{ kg pucuk layu/jam} \\ &= 581.710,4923 \text{ kg pucuk segar/jam} \quad 40 \end{aligned}$$

Capacity RV equivalent to tea dry :

$$\begin{aligned} &= \frac{20,94 \text{ kg teh kering}}{83,33 \text{ kg pucuk layu}} \times 484.739,3533 \text{ kg pucuk layu/jam} \\ &= 121.810,1771 \text{ kg teh kering/jam} \end{aligned}$$

b. Machine or CTC Knife

Processing time : 12 hours/ day

Roll diameter (d) : 8.25 inches = 0.20955 meters

Roll rotation (N) : 700 rpm

Roll length (p) : 0.8 meters

Shortest distance between rolls (s) : 1 mm = 0.001 meter

Bulk density : 0.4133 gr/ml = 413.3 kg/m³

Roll speed (v) : Roll circumference x roll revolutions

= π x dx N

= 3.14 x 0.20955 m x 700 rpm

= 460.5909 m/ min

= 27,635.45 m/hour

= 331,625.4 m/ day

Capacity machine CTC : vxpxsx bulk density x amount tool

= 27,635.45 m/hour x 0.8m x 0.001mx 413.3 kg/m³ x 2

= 18,274.7704 kg of powder milling / hour

Capacity equivalent CTC machine against shoots fresh :

$$\begin{aligned} &= \frac{100 \text{ kg pucuk segar}}{83,33 \text{ kg bubuk giling}} \times 18.274,7704 \text{ kg bubuk giling/jam} \\ &= 21.930,6017 \text{ kg pucuk segar/jam} \end{aligned}$$

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Capacity equivalent CTC machine against tea dry :

$$\begin{aligned} &= \frac{20,94 \text{ kg teh kering}}{83,33 \text{ kg bubuk giling}} \times 9.137,3852 \text{ kg bubuk giling/jam} \\ &= 4.592,2680 \text{ kg teh kering/jam} \end{aligned}$$

Discussion





Based on results calculation obtained that capacity *Rotorvane* is 484,739.3533 kg of shoots wilt / hour, capacity equivalent to fresh shoots 581,710.4923 kg shoots fresh wilt /hour, and capacity equivalent to tea dry 121,810.1771 kg tea dry /hour. Meanwhile For CTC mill, its capacity is 18,274.7704 kg of powder milling /hour, capacity equivalent to fresh shoots 21,930.6017 kg shoots fresh wilt /hour, and capacity equivalent to tea dry 4,592.2680 kg of tea dry /hour. Capacity the show heavy shoots withered and powder tea that is capable processed by GLS, *Rotorvane*, and CTC machines (Seenivasan et al., 2008).

Milling process mechanism tea black CTC starts from Rolling *rotor vane* shoots wilt and will result in change size from shoots wilted. Then shoots that have rolled up and a little destroyed will carried by conveyor going to CTC *roll* knife for crushed. The powder that has been destroyed and have uniformity size will enter into CFU. Things that need to be noticed in installation CTC *roll* knife is Don't install knife *roll* too wide or too narrow. Installation too sharp a knife wide will cause shoots become not enough smooth, while too much installation narrow make the *roll* knife will often friction this CTC *roll* knife will cause improvement heat on the shoots resulting in powder become *brownish*.

At the factory Sidamanik, mill done as much as two stages and uses different machines. Milling First use *Rotorvane* (RV) Φ 15" and grinding second use *Crushing Tearing Curling* (CTC) 4 units. Inside the RV Φ 15" there is a conducting unit that will push shoots tea towards the propeller, then shoots will destroyed by the rotating propeller towards pieces tea rough. From RV Φ 15", top tea brought going to CTC tool uses *conveyor* equipped with magnets for take object foreign / possible metal followed. Income material to in RV Φ 15" no may too a lot so as not to inhibit and the results Can maximum (Dey, 2014).

Milling with CTC itself aim For form grains tea in accordance with shape and size certain. The machine used that is *Teaman 36" CTC Machine 4 Cut* which has 4 pairs of *rolls* sequentially. Where the magnitude strength partner *roll* First is 25 HP/1500 rpm, *roll* second 25 HP/1500 rpm, *roll* third 20 HP/ 1500 rpm, and *roll* fourth 20 HP/1500 rpm. While arrangement knife regular cutter used in factories Sidamanik is 8, 10, 10, 10. This is due to size powder the tea produced from arrangement knife 8, 8, 10, 10 is considered not enough Good.

Each CTC machine consists of from two rotating *roll* opposite direction with speed spin 70 rpm and 700 rpm. Difference speed This aim For create stages between *rolls* One with others so that piece tea can crushed. Opposite rotation different directions and speeds will result in blow as many as 10 million times/ minute (Feng et al., 2020). Powerful movement the will result in leaf tea cut, torn, and destroyed in a way perfect. Liquid cells that come out with easy absorbed back by the wreckage leaf in a way fast and even. Destruction very even leaves will support the occurrence of biochemical processes. In short, the effectiveness of the grinding process will be very influential on the fermentation process at the stage next. For the treatment alone, usually will done grinding knife in a way periodically between 60-70 hours of use.

CONCLUSION

The conclusions that can be drawn from the Field Work Practice activities are as follows:

1. Sidamanik Plantation is one of 24 tea plantations under Sidamanik Plantation Unit of PTPN IV which is located in Sidamanik sub-districts
2. The Sidamanik factory's CTC black tea production results are then sent to the parent factory to be mixed there and the composition is regulated by the technology department because the Ciater factory's CTC black tea products do not yet have a sales label.
3. At the Sidamanik factory, milling is carried out in two stages using a *Rotorvane* (RV) Φ 15" machine for the first milling and the second milling using a *Teaman 36" CTC Machine 4 Cut* which has 4 pairs of consecutive rolls.
4. The *Rotorvane* capacity is 484,739.3533 kg of wilted shoots/hour, the equivalent capacity for fresh shoots is 581,710.4923 kg of fresh wilted shoots/hour, and the equivalent capacity for dry tea is 121,810.1771 kg of dry tea/hour.
5. The milling capacity of CTC is 18,274.7704 kg of ground powder/hour, the equivalent capacity for fresh shoots is 21,930.6017 kg of fresh wilted shoots/hour, and the equivalent capacity for dry tea is 4,592.2680 kg of dry tea/hour.

Suggestion

The suggestions for Sidamanik Plantation Unit of PTPN IV and future Field Work Practice activities are as follows:

1. The use of supporting tools such as safety equipment and work protection needs to be increased to ensure occupational health and safety.
2. Discipline and cleanliness in the factory environment need to be improved.

The involvement of active roles of PKL students in the production process is further increased



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